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BOWER'S
MEMORANDA
FOR THE
COLLEGE
OF
SURGEONS

BOWER'S

MEMORANDA

ON

Difficult Subjects

IN

ANATOMY, SURGERY,

AND

PHYSIOLOGY.

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ON
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IN
ANATOMY, SURGERY,
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PHYSIOLOGY:

Forming a Pocket Companion for the Young Surgeon
or for Students preparing for Examinations.

FOURTH EDITION,
CORRECTED AND ENLARGED.

HENRY RENSHAW,
356, STRAND, LONDON.
1872.

160. g. 42.

LONDON:
SAVILL, EDWARDS AND CO., PRINTERS, CHANDOS STREET,
COVENT GARDEN.

PREFACE.

THE branches of medical education are so numerous, that the best memory often fails in retaining even the principal facts without frequent reference to works on the different subjects; and it is by enabling a student to do this quickly that summaries have been found so highly useful.

With the desire of thus affording assistance, the former edition of the "MEMORANDA," by Dr. Druitt, was published, and its rapid disposal fully testified to the estimation in which it was held.

A new edition being now called for, and the work having been placed in my hands for revisal, I have been induced to re-arrange and considerably enlarge it, by more fully treating of many of the subjects, and by the addition of chapters on others not previously mentioned.

The brief description of parts has been faithfully given from standard works; and, as far as the limits would admit, mention of most of those which are of practical importance has been made.

MARK NOBLE BOWER.

The success which this work has enjoyed for so many years, is a proof of its great usefulness in assisting the student of medicine in the condensation and arrangement of the information necessary to his examination. It is now corrected and enlarged, and in its amended form will, I trust, prove worthy of its past as of future success.

M. W. Hilles.

A new edition of this work having been called for, care has been taken to bring it up to the present state of information upon those matters it treats of, and as far as its limited size admits. Being only intended as a *remembrancer*, it must be borne in mind that acknowledged text-books are first to be consulted, and that the amount of knowledge requisite for modern examinations requires hard work in the dissecting room, physiological laboratory, dead house, and wards. It is hoped that the present edition may in no way fall short of its predecessor's popularity.

E. B.

February, 1872.

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ERRATUM.

Page 126, 223 *bis*, *for* Mammà *read* Mammæ.

MEMORANDA

ON

Difficult Subjects

IN

ANATOMY, SURGERY, AND PHYSIOLOGY.

CHAPTER I.

REMARKS ON THE ANATOMY AND SURGERY OF THE OSSEOUS SYSTEM.

1. **Bones** form the passive organs of locomotion, and serve as a basis or support for the other portions of the body. There are two kinds of structure in different bones, and different parts of the same bone—viz., the *compact* and the *cancellous*; they are covered by a membrane, except where entering into joints, called *external periosteum* (περὶ about, ὀστέον.) Where there is a cavity, as in long bones, they have a lining membrane called medullary, or *internal periosteum.* The *periosteum* is a dense fibrous membrane, highly vascular, adhering to the surface of bones in nearly every *part excepting* their cartilaginous extre-

mities. It consists of two layers, the outer of connective tissue, and sometimes a few fat cells; and an inner, of fine elastic fibres, forming a dense membranous network. The periosteum is incorporated with tendons and ligaments at their attachment to the bones.

2. Arteries enter and veins emerge from bones, as may be seen in injected specimens. Those of the *compact* tissue, are derived from a network of vessels in the periosteum. Those of the *cancellous*, by larger vessels and fewer in number, which perforate the outer, compact tissue. The medullary canal of long bones is supplied by one or more large *nutrient* arteries, entering the compact tissue obliquely, generally about the centre of the shaft. The *veins* have very thin walls adhering closely to their long canals, and remain open when the bone is divided, thus accounting for the occurrence of purulent absorption after amputation. *Nerves* are freely distributed to the periosteum, and can be traced into the bone. *Lymphatics* have been shown to exist in large numbers.

3. The membrane covering the bones of the skull is also called periosteum, and is covered by the *pericranium;* the dura mater is the internal periosteum; the covering cartilage, is called the *perichondrium.*

4. *The chemical structure* of bone varies at different periods of life. In adult age, animal and earthy matters are nearly equal in quantity, the former predominating in childhood, the latter

in old age. In one hundred parts, about fifty consist of *gelatine,* or animal jelly; thirty-seven, of *phosphate of lime:* ten, of *carbonate of lime:* there are also traces of *fluate of lime, phosphates of magnesia and soda, chloride of sodium,* and, according to some writers, *oxides of iron, manganese, silica,* and *alumina.*

5. By immersing bones in hydrochloric acid, the earthy matter is formed into a chemical salt, which is dissolved out from the animal matter; the bone then becomes flexible: by calcination, on the contrary, all the animal matter is destroyed, and it is then rendered friable and brittle.

6. Bones are divided into *long, short, flat,* and *mixed:* the long ones are found principally in the extremities, where strength and extent of motion is required; short ones in the hands and feet, where very frequent but not extensive motion is necessary; the flat protect cavities, as in the skull and pelvis; whilst the mixed are found where both motion and protection of organs are requisite, as in the ribs.

7. *Long* bones consist of a shaft and expanded extremities; in the former, the tissue is compressed, and is called the *compact portion:* in the latter, it is expanded into cells, and is denominated the *spongy,* or *reticular—e.g.,* femur, humerus.

8. Flat bones consist of *plates,* or *tables,* and internal cellular structure, or *diploë.* The short bones are spongy, covered by a thin layer of compact tissue—*e.g.,* skull, scapula.

9. *Epiphyses* (*ἐπιφύομαι, adnascor*) are the articular extremities of long bones, having distinct points of ossification, and are so called only before they are united to the shaft by bony matter; *apophyses*, are projecting parts, or processes formed separately from the rest of the bone (*ἀποφύομαι, exorior*). The *diaphysis* is the shaft of a long bone. A knowledge of the exact period of union of the epiphyses with the shaft is of great importance in practice and in medico-legal cases.

10. *The development of calcareous matter* commences, about the fourth week of fœtal existence, by points of ossification first showing themselves in the clavicle, afterwards in the lower jaw, ribs, larger bones of extremities, and head, and finally in the vertebræ, tarsus, and metatarsus; whilst some few bones, as the patella, are not developed till after birth. As the ossific matter increases the cartilage diminishes, and at length no traces of it are to be found.

11. *Epiphyses* are rarely united to the *diaphyses*, or shafts, before the age of twenty, or later.

12. *Fractured bones* are thus united: coagulable lymph is effused into the cellular tissue around the fracture by the inflammatory process, the ends of the bone become softened, and are united by the lymph, ossific matter is then deposited in these structures, which become consolidated in from three to six weeks, according to the age of the person and the bone fractured. At first no *medullary canal* exists, and the bone is larger than

natural, but the absorbents restore the bone to nearly its original state, and the medullary canal is re-established.

13. In flat bones the mode of union is similar, except where there is loss of substance, as in trephining the cranium, gun-shot wounds, &c.; in these the loss is seldom repaired. A portion only at the circumference being replaced, the centre is completed by a thick membrane.

14. Many fractures within or near joints are united by ligament or cartilage—viz., the neck of the femur, patella, olecranon, and os calcis: this is principally owing to deficiency of periosteum, but partly to the difficulty of maintaining position. Longitudinal fractures of the patella unite by bone.

15. The different species of fractures depend upon the nature and extent of the injury. They are—1st, *transverse;* 2nd, *oblique;* 3rd, *longitudinal;* 4th, *comminuted;* 5th, *compound;* 6th, *complicated;* and 7th, *compound comminuted.*

Transverse consists of simple lesion across the axis of the bone; this is the most easy to treat, as the broad ends of the fracture oppose any displacement.

In *oblique*, the lower end of the bone is liable to be drawn upwards and backwards by the muscles.

Comminuted fractures depend upon a shattered state of the bone, portions of which may prove troublesome by acting as foreign bodies, and thus *delay the cure.*

Longitudinal ones frequently extend into joints.

Compound, are those in which there is a wound of the soft parts communicating with the fracture. Where, in addition to the fracture, there is a dislocation, injury to arteries, or to any vital organ, it is called *complicated*. A *compound comminuted* fracture, is one in which the bone or bones are not only shattered and broken up, but complicated with protrusion through the surface.

16. The general symptoms of fracture are, *shortening* of the limb, *change in its form*, *crepitus*, *preternatural mobility*, but *loss of power of motion*; all these are not always present, different fractures presenting different symptoms.

In dislocation, there is generally shortening and alteration of axis of limb, but in this injury the alteration of axis occurs at the joint, whereas in fracture it is between the joints.

17. The *treatment* consists in placing the bones in apposition, keeping them there till permanent union by bone has taken place, and subduing inflammatory symptoms:—the first is effected by extension and counter extension, and thus overcoming spasmodic action of muscles; the second, by means of splints, bandages, and rest; whilst inflammation is subdued by lotions and general treatment.

When splints cannot be used, from laceration or contusion, fracture boxes are used successfully, as they admit of lotions and dressings being applied *to the injured part.*

When rest is not observed, or, from some deficiency in the reparative process, such as caused by syphilis, struma, rachitis, &c., fractures do not always unite; a ligamentous capsule and a synovial membrane then cover the broken ends of the bone, and a false joint is established. The treatment for non-union consists in rubbing the ends of the bone together, passing a seton through, or even in sawing off a small portion. *Constitutional* treatment in these cases is most important.

18. A compound fracture extending into a joint with protrusion of bone, does not imply the necessity of amputation; in such a case, if extension will not reduce it, the end of the bone protruding may be sawn off: where there is much laceration of parts, or where large arteries and nerves are wounded, and where the bones are much shattered about joints, amputation is necessary. In these cases, this operation should be performed either *immediately*, or when *suppuration* has set in; but should *traumatic gangrene* come on, the operation may be performed before the suppurative stage is established.

A compound fracture which does not require amputation, should be converted into a *simple one*, if possible; this is effected by closing the external wound, having previously removed all extraneous substances, and by sawing off the protruding end of bone, if impossible to return it to its situation *by other means.*

19. All diseased states, old age, superficial situation, and the functions of some bones, as the clavicle, constitute the *predisposing causes* of fractures; whilst external injuries, as blows, falls, gunshot wounds, and the violent action of muscles, are considered *the remote ones.*

The spasmodic action of muscles is a great obstacle in the reduction of fractures; it is overcome by bandages, splints, rest, position, and opiates, and the administration of chloroform.

20. The *readjustment* of improperly set fractures may be attempted generally during the first two or three weeks. After this time the union is so firm as to prevent much success; when the bones are completely united, we are not justified in using violent means, although cases will from time to time occur in which the surgeon must use his own discretion with regard to refracture.

21. Childhood facilitates the union of bone; old age retards it; diseases, and such states of constitution as indicate debility, sometimes altogether arrest it.

22. When a *cartilage* is broken, ossific matter is deposited round the part, and bony union takes place.

DISEASES OF BONES.—PERIOSTEUM.

23. The diseases which affect the *osseous system* are, (1) Those depending on *hypertrophy*—e.g., *simple hypertrophy, exostosis.* (2) Those depending on *atrophy* and *degeneration*—e.g., atrophy,

rickets, mollities ossium. (3) Inflammation and suppuration of bone and periosteum—e.g., *acute* and *chronic inflammation, periostitis, abscess, necrosis, exfoliation, caries, nodes.* (4) *Tumours cancer, osteo-sarcoma, cysts, osteo-aneurism.* (5) *Neuralgic* affections.

24. Thickenings of periosteum from syphilis are called *nodes:* they arise from infiltration of the periosteum with gummy exudation, and may extend to the bony structure.

Inflammation of bone may be *acute* or *chronic; simple* or *specific:*—the symptoms vary in severity. Thus, in some cases where an accidental cause has produced the disease, the pain is inconsiderable, whilst in syphilis it is characterized by great severity and exacerbations. In *scrofulous* inflammation the bone is perceptibly lighter than natural.

25. When a long bone is attacked by inflammation, the disease generally results in *necrosis* or mortification: this termination is analogous to gangrene of the soft parts, and is the result of the lesser vascularity of the compact tissue of the shaft. The symptoms differ, according to the nature of the cause and extent of the disease:—there is *deep-seated pain;* general and unyielding *swelling* of the limb, without any definite boundary, and often involving the next joints; *formations* and *escape of matter* by fistulous openings, without any diminution in size *of part:* through these openings, or cloacæ, por-

tions of dead bone, called *sequestra*, are felt with a probe; the formation of pus converts the *sympathetic* fever accompanying the first stage into *hectic*, and greatly reduces the patient.

In the treatment of this disease, it must be remembered that no cure can be made till the dead bone has been removed; this, however, must not be done, unless the sequestrum is entirely separated from the living bone; when such separation has taken place, the bone may be exposed by opening the soft parts with a bistoury, and then using small trephines;—tonics, rest, and time, then generally complete the cure, which is, however, very slow. Reparation takes place thus:—A crust of new bone is formed around the sequestrum; this is then removed, either by the efforts of nature or artificially. Much interference is not judicious. Epiphyses are rarely affected.

26. *Caries* or molecular disintegration resembles ulceration of soft parts; it attacks the bones which are of a spongy nature, is most frequent in young persons, and may result either from simple inflammation, scrofula, or venereal disease; in general, an abscess forms over the part, which at length bursts, discharges a thin ichorous matter, and gives passage for the escape of particles of diseased bone. It is very slow in its progress, and does not end in reproduction of osseous structure, but in approximation of the surfaces; this is well seen in caries of the vertebræ.

The treatment consists in counter-irritation;

or, where the disease arises from specific causes, as syphilis, scrofula, scurvy, in giving remedies adapted to those diseases; excision of the carious part will sometimes arrest the complaint and induce a healthy action of the surrounding structures.

27. Exfoliation resembles necrosis, but attacks, in general, the flat bones; it is frequently caused by destruction of the periosteum and exposure of the bone, but arises also from other causes. The term signifies necrosis of a thin superficial layer, not inclosed in any shell of bone. The treatment is similar to caries and necrosis, but cases of this kind are very slow in their progress.

Mollities ossium is a very rare disease, and generally occurs in the female, and at the early periods of life; it is caused by absorption of the earthy matter, which then often constitutes only one-fifth of the bone; in *rachitis* on the contrary, there is a deficiency of earthy matter from birth.

28. *Suppuration* occurs in the medullary cavities (*osteo-myelitis*), or in the cancellous structures of bone; the symptoms are often very obscure, and differ much; in cases of these kinds the absorption occasionally takes place to a great extent.

29. *Spina bifida* consists in a deficiency of some of the spinous or other processes of the vertebræ or sacrum, and a tumour containing cerebro-spinal fluid and nerves, having as its sac the investing membranes of the cord and integument. It generally proves fatal, as a child affected with it rarely lives after the age of three.

30. *Exostosis* is a tumour formed by irregular hypertrophy — having the structure of ordinary bone. Painless, unless it presses upon important structures, when it may give rise to serious results.

Remarks on the other diseases of bone above enumerated will be found in the sections on scrofula, syphilis, &c., and in other parts of the work.

CHAPTER II.

ON SEPARATE BONES.

The Spinal Column and Bones of Head.

31. The spinal column, situated at the middle and posterior part of trunk, consists of two pyramids applied to each other by their bases; the lower is formed by the sacrum and os coccyx: the upper, by the true vertebræ, of which there are twenty-four—viz., *seven cervical, twelve dorsal,* and *five lumbar.* Each of the vertebræ have a *body, seven processes, two peduncles, two laminæ, two notches,* and a *foramen:* they are of mixed structure, and are developed in general by three points, one for the body, the others for the lateral and posterior parts. The body is cancellous, with a more dense covering to protect it; the processes are of compact tissue, but become spongy where enlarged. Each of the three classes of vertebræ have distinct characteristics, whilst some in each *class differ from* the others in same class; thus

the last of the cervical resembles the first of the dorsal, and the same resemblance is observed at the termination of the dorsal.

32. *Cervical vertebræ* are characterized by the greatest length of body being from side to side, by the greatest depth being in front, by the superior surface of same being concave, and surmounted by two projecting alæ or *laminæ;* by the spinous processes being bifid,—the transverse bifid, and perforated by foramen for vertebral artery —the laminæ narrower and longer than in other classes of vertebræ—the foramen for spinal marrow large and somewhat triangular—and the notches for exit of nerves anterior to articular processes.

33. *Dorsal vertebræ,* intermediate in size, have the body largest from before backwards, thicker posteriorly than anteriorly, and marked above and below by articulating surfaces for the ribs, of which the upper facet is the larger; the transverse processes long, thick, directed backwards, and marked by a smooth facet for the tubercle of a rib; the spinous processes long, imbricated, directed downwards, and terminating in a tubercle; the foramen small and circular.

34. *Lumbar vertebræ* are the largest, have the greatest diameter of body transversely, which is thicker anteriorly than posteriorly; spinous processes transversely flattened, thick and horizontal —transverse, thin, and directed directly outwards —notches deep, especially lower—medullary foramen triangular. In the cervical region the

superior articulating processes look upwards and backwards, the inferior downwards and forwards: in the *dorsal*, the superior look directly backwards, whilst the inferior are directed forwards: in the *lumbar*, the superior look not only backwards but inwards; the inferior, outwards and forwards.

35. *Peculiar cervical V. First cervical vertebra*, or atlas, is a mere ring of bone, having neither body nor spinous process: it is thickest at the articulating processes, and has the ring, which occupies its whole diameter, divided into two by a projecting portion of the articulating process; the posterior of these rings occupies four-fifths, and is for the spinal marrow; the anterior is marked by a smooth facet for the odontoid process which lies in it. A ligament, called transverse, separates these foramina: the transverse processes are large, but not bifurcated.

Second cervical vertebra, or axis, presents on the upper surface of body a process called odontoid, on the anterior and posterior surface of which are two smooth facets: on anterior surface of body are two depressions for longus colli muscles; its spinous process is large, bifid, looks directly backwards, and has a deep channel on inferior surface; transverse processes are small but not bifurcated; medullary foramen very large; on the anterior and inferior part of the body there is a projecting portion for concave surface of next vertebra.

Seventh cervical resembles dorsal; it has an elongated spinous process, and is not always perforated by the vertebral foramen.

Peculiar dorsal V. First dorsal differs from others of this class in having a perfect articulation for first rib besides half a one for next.

Tenth, eleventh, and twelfth dorsal have each a distinct facet for the articulation of a rib: the two last have no articulating surface on the transverse process.

36. The *ribs* are in number twenty-four—viz., twelve on each side; they are divided into seven true and five false—increase in size down to the eighth, and then diminish to the twelfth. The first is nearly horizontal, whilst the others are suspended more or less obliquely from the vertebræ. The parts of a rib are—head, neck, tubercle, body (on which last is the angle), sternal extremity, and groove for intercostal artery. The head is divided by a ridge into two articulating surfaces for attachment to the bodies of vertebræ—a similar articulating surface is seen on the tubercle:—these last marks are not observable on the three last ribs:—the sternal end is concave for articulation with cartilage.

On the upper surface of the first rib, which looks upwards, there is a tubercle for the attachment of scalenus anticus, in front and behind which are grooves for the subclavian vein and artery: this rib has no angle, and is destitute of groove. The distance of the angle from tuberosity *increases gradually* from second to eleventh, whilst in twelfth it is not perceptible. There is one point of ossification for the head, one for the tubercle, and one for the body; the epiphysis which becomes the tubercle is isolated to the age of eighteen or twenty.

37. *The sternum* is composed of three pieces: the upper one, called manubrium, is triangular, and attached at its inferior margin to the next portion or body: this is much longer than the manubrium, and is marked by transverse lines, indicating its original division in the fœtus: at the upper angles of the manubrium are two sigmoid-shaped surfaces, looking upwards and backwards, for articulation with the clavicle: below these are situated two other articulating surfaces, the upper for the cartilage of first rib, the lower for half the second, the articulation being completed by the body of sternum: on the sides of this last are depressions, for articulating with half the second, the third, fourth, fifth, sixth, and part of the seventh ribs.

The lower portion of this bone, called xiphoid, or ensiform cartilage (*ξίφος* a sword, *εἶδος* figure), is sometimes ossified, but generally cartilaginous; —it gives attachment to the muscles of the abdomen, and is sometimes bifurcated and perforated by foramina for passage of vessels.

The structure of the sternum is spongy, and the development by *eight* or *nine centres of ossification.*

38. *Bones of head and face* are twenty-two in number—viz., occipital—frontal—ethmoid—sphenoid—*two parietal*—two temporal *forming cranium*;

—two superior maxillary—two malar—two nasal —two lachrymal—two palate—two inferior turbinated—vomer—and inferior maxillary, *forming face;* of these, one, *the frontal,* is common both to cranium and face;—sixteen are symmetrical, or in pairs—six single. In addition to these, there are seen many loose triangular-shaped bones situated in the sutures, called *ossa triquetra,* the number of which depends upon the rapid growth of the brain.

The bones of cranium have two tables, of which the inner is called vitreous, from its very brittle nature; between these plates is the diploë, which is, however, at some parts deficient, and leaves cavities, as the frontal and sphenoidal cells. These bones offer the best specimens of the class of flat ones, but are not of equal thickness throughout: on their inner surface they are marked by elevations and depressions, which do not, however, accurately agree with the convolutions of the brain: the external surface is smooth, and covered by periosteum, over which plays the occipito-frontalis muscle; the dura mater forms the inner periosteum: all these bones are united by sutures, which sometimes become ossified towards old age. On the upper surface, in the median line, are seen in the child the two *fontanelles,* of which the anterior, quadrilateral in shape, is formed by the angles of the parietal and frontal bone not being ossified at this age; the posterior, triangular in shape, is formed by a similar deficiency in the posterior angles *of the parietal* and the superior angle of occipital bone. At the posterior aspect of the skull are seen two lines, called transverse ridges: these are intersected by a perpendicular ridge, which commences in the centre of the superior, at a tubercle called the occipital protuberance, and terminates at the foramen magnum; these ridges, and spaces between, are for the attachment of muscles. At the anterior aspect of the skull are seen the orbital margins—above which are two other ridges, called superciliary, and between these, in the median line, is an eminence, indicating the situation of the frontal sinus: at the sides of cranium are also seen two ridges commencing at external angle of the eye, and extending along the frontal, parietal, and temporal bones, to the mastoid process; these are called the temporal ridges, and give attachment to temporal muscle. On the inner surface of the bones of the head is seen a furrow extending along the frontal superior margin of parietal bones, and portion of occipital for superior longitudinal sinus; this groove divides opposite the internal occipital protuberance into two, for the lateral sinuses, which after grooving the occipital, posterior inferior angles of parietal, mastoid portion of temporal,and occipital, pass through the foramen lacerum posterius, and are then called internal jugular veins;—beneath the lateral sinuses are situated the lobes of cerebellum; above them are the posterior lobes of cerebrum; an internal occipital ridge separates these cerebellar fossæ, and *ends in the foramen magnum,* through which pass *the spinal cord,* vertebral arteries, spinal accessory nerves, and the theca vertebralis, which consists of dura mater, arachnoid, containing the cerebro-spinal fluid, and pia mater, the spinal arteries and veins. Anterior to this foramen is the basilar process which looks upwards and forwards; it is grooved on its upper surface, and gives support to pons Varolii; this process is attached to the body of the sphenoid bone, and towards the middle period of life is firmly united to it by ossific matter; extending outwards from this process are seen the petrous portions of temporal bones, marked on their upper surface by very distinct eminences, beneath which are the superior semicircular canals, and at their superior and inferior margins, by grooves for the petrosal sinuses; at the junction of these bones with the body of the sphenoid are seen the *foramina lacera media*, across which pass internal carotid artery and through them the vidian nerves. There are also seen on this petrous bone, posteriorly, the *meatus auditorius internus*, for the two branches of seventh nerve, *aqueductus cochleæ* and *aqueductus vestibuli* for veins; on superior aspect, *aqueductus Fallopii* for the greater petrosal nerve, whilst still more anterior is the entrance of *Eustachian tube*. In this bone are also situated the tympanum, vestibule, semicircular canals, and cochlea constituting the internal and middle ear. In the median line, and anterior to the basilar portion, is an elevated surface, the *sella turcica*, depressed in its centre, surmounted by four *clinoid processes*, and containing pituitary body. Immediately in front of this fossa is an eminence, *the olivary process*, on which lie in a groove the optic commissures—and on either side are two foramina, *optic-foramina*, for the passage of the optic nerves, and ophthalmic arteries. On the outer side of these are the *alæ majores* and *minores* of sphenoid bone: beneath them and looking backwards, are seen successively the *foramen lacerum anterius*, for the transmission of third, fourth ophthalmic branch of fifth and sixth nerves, together with ophthalmic veins and one head of external rectus muscle: *foramen rotundum* for second division of fifth nerve, and *foramen ovale* for third division of same; a little posterior and external to this foramen is the foramen spinosum for the middle meningeal artery, which grooves sphenoid, temporal, sphenoid and interior inferior angle of parietal; the whole inner surface of this last bone is also grooved for this artery, which supplies the dura mater, and through a foramen communicates with the arteries on the exterior. Here also are seen numerous depressions, in which are lodged the corpora Pacchioni. Anterior to clinoid processes and wings is seen a raised surface, having in its centre the *crista galli process* for attachment of falx cerebri; this process terminates anteriorly in the foramen cæcum: on either side of it is a perforated plate of bone, called *cribriform*, for olfactory and nasal twig of ophthalmic nerves: the surfaces of bone external to this are convex, *marked by elevations* and depressions, and offer support to anterior lobes of brain; posterior, and below the wings on each side, are the two concave surfaces for middle lobes of brain, Casserian ganglion, internal carotid artery, cavernous sinuses, and third, fourth, first portion of fifth, and sixth nerves, which pass through its outer wall. The cerebellar fossæ have been before mentioned; they lie much lower than this surface, and are separated from the posterior lobes by tentorium cerebelli.

39. The inferior aspect of skull presents, on each side of foramen magnum, the two condyles which approximate anteriorly, and articulate with atlas. In front of and behind these may be seen two foramina, the anterior and posterior *condyloid* foramina; the ninth nerve passes through the former, and a small vein and artery through the latter, when it exists. In a transverse direction from the condyles, and more external, are the *mastoid* processes and *digastric* grooves; these grooves give origin to digastric muscles, whilst the mastoid process, which is cellular in structure, has attached to it the sterno-cleido mastoideus, splenius, and trachelo-mastoideus. In front of the digastric groove is seen the elongated *styloid* process for the attachment of stylo-hyoid, glossus, and pharyngeus muscles, and for the stylo-maxillary and stylo-hyoid ligaments. Ossification of this process does not take place till some years after birth: around its base is a lamina of bone, *he vaginal process*, which extends inwards, and *parates* this surface into two parts; behind it

are seen the entrances of the internal carotid artery and *foramen lacerum posterius,* whilst anterior is *the glenoid cavity,* separated into two portions by *Glasserian fissure* for passage of *chorda tympani, laxator tympani muscle, tympanic artery,* and for attachment of *processus gracilis of malleus;* in the posterior part of this cavity is situated the parotid gland—in the anterior the head or condyle of the lower maxilla: between the styloid and mastoid processes is a foramen, *the stylo-mastoid* for portio dura nerve, and immediately external, the *meatus auditorius externus.* More internal, and on the lower aspect of petrous bone, we observe a rough surface for attachment of *levator palati and tensor tympani muscles:* before this surface are seen the spinous process of sphenoid bone for attachment of internal lateral ligament of lower jaw—opening for Eustachian tube—spinous foramen, for middle meningeal artery—foramen ovale, for third division of fifth—and pterygoid processes, and fossæ. Between the petrous bones, and anterior to foramen magnum, is seen *the basilar process* marked by pharyngeal spine and rough surfaces for attachment of rectus capitis anticus major and minor muscles, and the two superior constrictors of pharynx: this surface is separated from petrous bone by foramen lacerum medium, at the anterior part of which may be seen the posterior opening of *pterygoid foramen.* Situated in the root of this process is a *small cavity, the navicular fossa,* for circumflexus palati muscle, and at the extremity of the internal *pterygoid* plate is the *hamular process*, around which this muscle plays: the two large openings named *posterior nares* are between, and still more anteriorly the *palatine* surface, which is surrounded by alveolar process, and is perforated by the anterior nasal or palatine foramen, and two posterior palatine canals for transmission of descending branches of Meckel's ganglion and posterior palatine artery. On the outer side of the glenoid cavity is the *tuber articulare* for attachment of external lateral ligament of lower jaw; and from this point an arch of bone is seen extending forwards, which is called the *zygomatic process;* it unites with the malar bone, and bounds the temporal and zygomatic fossæ, and still more internally the spheno-maxillary and pterygo-palatine fossæ, in which last lies Meckel's ganglion, and immediately internal to which is seen the pterygo-palatine foramen, for transmission of nasal branches of Meckel's ganglion, and nasal artery.

40. *Orbital cavities*, situated at the upper and anterior part of face, are pyramidal in shape, with their bases directed forward: the internal wall of one orbit is parallel with that of the other, whilst the external ones diverge, and do not extend so far forward: a line drawn through the axis of each meets on the sphenoid bone; in either orbit are seven bones, the *frontal, ethmoid, sphenoid, malar, superior maxillary, lachrymal*, and palate: the three first are common to the two orbits, so

that there are only eleven bones entering into both. At the posterior part of this cavity are seen the *foramen lacerum anterius* and *foramen opticum;* extending outward, and separating the outer from inferior wall, is the *spheno-maxillary fissure,* across which passes the infra-orbital nerve and artery; in the inferior wall is seen the canal along which this nerve and artery run: on the inner surface are two foramina, the anterior and posterior *ethmoidal,* the first for transmission of nasal twig of ophthalmic nerve, the latter for the ethmoidal artery. Near the inner angle of the orbit is seen the *nasal canal,* opening below into the inferior meatus of the nose, and affording passage for tears from the eye; at the anterior upper and inner border is also seen a rough depression for the attachment of the pulley for the tendon of superior oblique muscle; in the outer and upper wall there is a depression for lachrymal gland, and in the superior margin a depression or groove, and sometimes a foramen, for passage of frontal nerve and artery; this nerve, which is a branch of the first division of fifth, supplies the forehead; immediately beneath the orbit is the anterior opening of infra-orbital canal, through which emerges the second division of fifth, whilst the third division passes through the inferior dental foramen in the lower jaw. The contents of the orbital cavity are *dura mater,* and *fat—globe of eye—lachrymal gland,* and *ducts—four recti, superior and inferior oblique,* and *levator palpebræ* *superioris muscles—lenticular ganglion—ophthalmic artery and branches—ophthalmic vein—second, third, fourth, first division of fifth, sixth, sympathetic, and ciliary nerves*; around the margins are placed *eyebrows, eyelids, ciliæ, Meibomian glands, reflections of mucous membrane,* and *puncta lachrymalia*—from which last proceed the small mucous canals terminating in nasal duct (*canaliculi*).

41. *Nasal cavities* are formed by fourteen bones—viz., the upper wall by *frontal, ethmoidal,* and *sphenoidal;* anterior wall by *nasal,* and *nasal processes of superior maxillary:* lateral walls *by ethmoid, superior maxillary, os lachrymale, inferior spongy* and *palate* bones: the *vomer, azygos plate* of *ethmoid* bone and *cartilage of nose* divide this cavity into two parts, extending from anterior to posterior nares: in each lateral half are three channels, called *superior, middle,* and *inferior meatus;* into the superior open the posterior ethmoidal, and sphenoidal cells, and pterygo-palatine foramen; into the middle, the anterior ethmoidal cells, frontal sinus, and antrum Highmorianum; into the inferior, the lower opening of lachrymal canal. The nose is lined with mucous membrane, the bones forming its interior are exceedingly delicate, and are composed of thin, compact, and some spongy tissue; it is liable to caries, exfoliation, tumours, syphilitic ulceration, polypi, disease of antrum, and malignant diseases of bones.

42. This cavity is increased by the ethmoidal

and sphenoidal cells and frontal sinus, all of which are lined by the same membrane, and are subject to the same diseases; in the outer wall is the *antrum Highmorianum*, of a pyramidal shape, situated in the superior maxillary bone, bounded below by alveolary process, laterally by sides of the superior maxillary bone, and superiorly by orbital plate of same bone; it is lined by mucous membrane, and is liable to be affected by *abscess*, *hypertrophy*, *exostosis*, *enchondroma*, *fibro-plastic tumours*, *fibrous tumours*, *encysted tumours*, and *cancer*.

43. Ossification takes place in the bones of head and face by numerous points: in the *occipital* are four ossific centres, one of which is for the basilar process, one for each condyle, and one at the protuberance. The *parietal* bone has one ossific point alone, which is in the centre. The *temporal* has six centres of ossification, one for petrous portion, one for external auditory canal, one for squamous portion, one for mastoid, one for zygomatic, and one for styloid process. In the *frontal* are seen two, corresponding to frontal eminences; in the *ethmoid* there are three, for the middle and two lateral regions. The *sphenoid* has seven points—viz., for the body, for bases of pterygoid processes, wings and inner pterygoid plates:—the *vomer*, *palate*, *inferior turbinated*, *nasal*, *lachrymal*, and *malar* bones, are developed by single points of ossification: in the *lower maxillary* bone *there are two*, whilst in the superior maxillary are

several, corresponding to alveolary arch, body, palate, malar and orbital processes.

44. *The teeth* are thirty-two in number in the adult—consisting of eight incisors, four cuspidati, eight bicuspidati, and twelve molares; the last are deficient in childhood. *A tooth* consists of a *crown*, a *neck*, and a *root;* the first is above the alveolary ridge, and is covered by enamel, the root is within it, whilst the neck is intermediate. The structure of the teeth is nearly the same as the other bones, with rather more fluate of lime, but no cellular intervals: the *enamel* contains gelatine, and its fibres are in a contrary direction to those of the other structure of the teeth; it does not contain any vessels, and when once destroyed is not renewed; in the crown is a cavity filled with a soft gelatinous fluid, called pulp; this communicates with the root by a canal, through which vessels, nerves, &c., enter: the periosteum of the lower jaw is reflected into the alveoli, and thence on to the roots of the teeth which it invests. The incisors and canine teeth are developed by single points of ossification;—the bicuspidati and molares have, in addition, one for each root.

ON THE DISEASES OF NASAL CAVITY.

45. The principal diseases of the nasal cavities are epistaxis and polypus.

Epistaxis, or bleeding from the nose, occurs at all *periods* of life:—in the young, from a congested state of the blood-vessels; in the old, from their being in a relaxed state. When mild, the application of cold to the nose and face, or back of the neck, will stop the bleeding; but in more severe cases it will be necessary to plug the nostrils with dossils of lint, or even the posterior nares.

Polypi are of four descriptions, the *gelatinous*, *hydatid*, *carcinomatous*, and *fungoid*. The *gelatinous* is the most frequent, and grows from the upper spongy bones; it is pear-shaped, of a greenish yellow colour, soft and streaked near its neck with small blood-vessels. The symptoms are, obstructions in the nose, especially in damp weather, and deformity. The tumour may be seen on examination. This form should be removed by the forceps.

The *hydatid* is very rare, and consists of a number of thin vesicles filled with a watery fluid; these burst on pressure, when nitrate of silver should be applied to prevent their return.

The other forms are malignant, and must be treated as in other parts of the body.

Ozæna, or *Rhinorrhœa*, is sometimes described as a disease, but is, properly, the consequence of disease, as venereal, scrofula, &c., &c.; it is fœtid discharge from the mucous membrane and nose.

Abscesses form in the antrum—they may be discharged by drawing one of the molar teeth in upper jaw.

CHAPTER III.

THE ANATOMY AND DISEASES OF JOINTS IN GENERAL.

46. ARTICULATIONS are of three kinds:—

1st, *Diarthrosis* (Διὰ per, ἄρθρον articulus), a moveable joint—comprising *enarthrosis* (εν in, ἄρθρον), a ball-and-socket joint; *ginglymus* (γιγγλυμὸς, cardo), a hinge joint, which is either rotary or angular; *Arthrodia* (ἄρθρον), an articulation of plane surfaces with distinct motions.

2nd, *Amphiarthrosis* (ἀμφὶ utrinque, ἄρθρον) constitutes the second division: in this species there is an intervening substance with very obscure motion, as in the bodies of the vertebræ, and symphysis pubis.

3rd, *Synarthrosis* (Σὺν cum, ἄρθρον) is an immovable articulation, and is divided into—1st, *Suture*, as in the bones of the head; 2nd, *Harmonia*, where surfaces are simply in contact, as in the articulations of the nasal bones; 3rd, *Gomphosis*, where a bone is implanted into another, as a tooth in the socket; 4th, *Schindylesis*, where a ridge of bone is received into a groove in another bone, as in rostrum of sphenoid and upper edge of vomer.

47. The tissues which enter into the formation of *joints* are—1st, *bone;* 2nd, *cartilage;* 3rd, *ligament;* 4th, *fibro-cartilage;* 5th, *synovial membranes;* and 6th, *muscles.*

The ends of the bones entering into joints are enlarged, of a spongy nature, covered by synovial membrane instead of periosteum, are retained in situation by ligaments and muscles, which are invested with a layer of cartilage, which protects them, and gives elasticity to the joint. Some, as the knee-joint, lower jaw, and sterno-clavicular, possess moveable fibro-cartilages in their interior.

48. *Cartilage,* one of the elementary tissues, is elastic, compressible, and of a yellowish-white colour; no blood-vessels have been traced into it, its nutritive supply being derived from the adjacent synovial membrane and bone, but it is destroyed in disease: its *chemical composition* is albumen, water, phosphate of lime, and gelatine. It consists of a basis of intercellular substances, in which are imbedded the cartilage-corpuscles. Inflammation attacks it, causes it to swell considerably, and generally terminates in erosion: it is adherent by one side to the epiphyses of bones—is thickest in the *centre* where situated on a convex surface—thickest at the *circumference* where lining a cavity.

49. *Fibro-cartilage* consists of cartilage, arranged in laminæ, and surrounded by fibrous membrane, which also intersects its layers; it partakes of the properties of both these tissues; is generally found in the immovable articulations, and is supplied with blood-vessels; the best illustrations of it are the intervertebral substances, which are highly elastic; it is also found in the *intervals of moveable* joints.

50. *Ligaments* are dense, fibrous structures, arranged either in the form of flat bands, of white glistening bundles, or of expanded membranes; they connect bones and cartilage together, and frequently enter into the joints: where such is the case, they are enveloped at their ends by periosteum; some of the folds of the peritoneum and fasciæ are also called ligaments; the interosseous ligaments, lateral ligaments binding the joints together, and capsular ligaments of hip and shoulder, are specimens of the first three kinds; the folds of peritoneum covering the liver, and those of the fasciæ covering the bladder of the last.

51. Minute examination shows that the fibres in ligament cross each other in all directions, whilst in tendon they all run parallel. Gelatine is found in both of these, but in ligament alone there is albumen in considerable quantities. Inflammation may occur, primarily, in this structure, but is generally the consequence of disease of cartilages and synovial membranes: it may terminate in thickening or ulceration.

52. *Synovial membranes* are shut sacs, and are applied over all the articulating parts of moveable joints:—in *appearance* they resemble serous membranes, but *in function* they differ from them, nor do they possess the same vascularity; in their diseases they have most similarity to mucous, as inflammation generally terminates either in *suppuration* or *ulceration*. Mucus, albumen, and *other organic* matters, together with fat, chlori

of sodium, sulphates and phosphates of the alkalis, carbonate of lime and earthy phosphates, are found in the fresh synovia secreted by the synovial membrane.

53. The *diseases* which attack joints are numerous; they are—1st, *Inflammation of the synovial membrane* (*acute and chronic, synovitis*); 2nd, *Fungous growths;* 3rd, *Ulceration of cartilages;* 4th, *Loose cartilages;* 5th, *Scrofulous;* 6th, *Syphilitic;* 7th, *Rheumatic affections;* 8th, *Hysterical;* and 9th, *Anchylosis.* The principal *accidents* are—*Dislocations, fractures, wounds, sprains,* and *foreign bodies* in joints.

54. Synovitis may arise from cold, syphilis, gout, rheumatism, phlebitis, mercury, or wounds.

When from cold, it occurs generally in the most unprotected joints; but when from wounds, it is most severe; in syphilis, rarely more than one joint is attacked at the same time, but in rheumatism several may suffer at once, or metastasis may take place. In *idiopathic disease* of joints, the inflammation generally commences in synovial membranes, but in scrofulous disease, in the bones.

The symptoms of *synovitis* are, swelling, heat, pain, fluctuation, and inflammatory fever, which is quickly converted into hectic.

The pain commences in one spot, spreads rapidly over the whole joint, and becomes very severe; in a day or two an increased secretion of *synovia takes place, which* becomes less albuminous tha natural; stiffness occurs, and the joint becomes swollen, especially where unprotected by ligaments; if not arrested, *synovitis* goes on to suppuration, ulceration of cartilages, and disease of the bones, or terminates in a chronic state, when the structures become much thickened, and the motion imperfect.

The *treatment* of this inflammation consists of local bleeding, by leeches and cupping, as far as the patient's strength will admit, fomentations, or cold lotions, purgatives, and rest; in severe cases, where suppuration occurs, free incision into the joint should be made (antiseptically) or tapped through an aspirator; in the chronic state, topical bleeding, blisters, bandages, liniments, and, towards the last, moderate use of the limb.

55. When *ulceration of the cartilages* has taken place, and the disease has extended to the bones, the most favourable termination is *anchylosis*, as these substances are rarely reproduced; for this state, *rest*, *counter-irritation*, such as issues, moxas, antimonial or savine ointment, blisters, and *local bleeding*, constitute the treatment; towards the last, *pumping cold water* on the part, and *tonic medicines* have proved of service.

56. *Scrofulous disease* is the most frequent of all the affections of joints; it may commence in the ends of the bones, which are of a cancellous structure; or in the synovial membrane, or in both, more rarely in the soft tissues near the joint; is *most* frequent in the ankle, knee, elbow, and

hip joints; occurs in scrofulous habits of body, and is called *white swelling.*—There are three stages—1*st*, when the disease is confined to the bones; 2*nd*, when the external parts are thickened and swollen; and 3*rd*, the stage of suppuration, with ulceration of cartilages, abscess, and dislocation. *Lameness* is the first symptom; then *pain*, which extends down the limb, and is often referred to a neighbouring joint; has its true seat discovered by striking or moving the limb, but is not so severe as in other diseases; *tension, smoothness*, and *whiteness* of the skin; loss of shape of joint; lengthening of limb, partly from inflammation, but principally from the position in which the patient stands, and which is afterwards converted into shortening, abscesses, dislocation, inability of standing upon the limb, sympathetic or hectic fever, and emaciation. When once excited, this disease is very difficult of control; it most frequently occurs in childhood, and is very generally attended by other symptoms of a scrofulous tendency.

The *treatment* during the active stage consists of fomentations, lotions, poultices, purgatives, and rest; if suppuration occur, the abscesses should be carefully opened; where the disease has arrived at a more chronic state, of counter-irritation, sea air and bathing, external applications of iodine, or occasionally of leeches, stimulating liniments, and of pressure. Scott's dressing sometimes of use.

57. *Loose cartilages* are formed either within or on the external surface of synovial membranes,

and, according to Sir Benjamin Brodie, are often generated like other tumours; they appear to be perfectly cartilaginous in structure, and differ in size from a pea to a small patella; when placed between bones they are characterized by intense pain and loss of power of motion; if much annoyance is occasioned by them, removal may be resorted to, but as inflammation frequently follows this operation, it should not be attempted whilst the joint is in a painful state. Most frequent in knee.

58. *Ulceration of cartilages* may either occur primarily, or may be the result of synovitis; it is most frequently observed in adults, is accompanied by a fixed pain referred to one spot, without swelling in the first instance; but after some weeks, or even months, the swelling appears, the pain is worse at night, effusion takes place, and fluctuation is felt; when any of the cartilages are thus destroyed, and caries has attacked the bones, the most favourable termination is anchylosis of the joint; the treatment is the same as in the other inflammatory diseases of these parts.

59. When scrofula attacks the hip joint, it is called *coxalgia*, or morbus coxæ, and has some symptoms which are not found in other joints; it occurs in childhood, generally before fourteen years of age, but sometimes later, and is indicated by pain in the knee (to which joint pain is first referred) and ankle along the course of the saphenic nerve; the leg is dragged after the sound one and *the fold of* the nates disappears; but if pressu

be made, or the limb rotated, the pain is then felt in the joint affected; the glutei muscles waste away, the thigh inclines forward, and the limb is kept somewhat bent; in other respects, the symptoms resemble those of other scrofulous diseases of joints, and the same plan of treatment is required; the most favourable termination is spontaneous dislocation, and formation of a false joint on the dorsum ilii. Excision very successful as a rule.

60. Dislocations occur most frequently in joints which admit of motion in *every* direction; where the motion is *limited*, the ends of the bone are, generally, only partly displaced.

Where, in addition to the dislocation, there is a wound communicating with the joint; it is called *compound*—when accompanied with fracture of bone, *complicated.*

61. The *causes* of dislocation are—violent action, or paralysis of muscles; smallness of articular surfaces, and relaxation of ligaments; diseases occurring in joints, as caries of bone; ulceration of cartilages, or collections of fluid; previous dislocations; and external violence.

62. The *symptoms* are—shortening, or, in two instances, lengthening of the limb; immobility; pain, and numbness; alteration in the axis; swelling, or flattening of the muscles; and general deformity of the joint.

63. These accidents may be distinguished from *fractures, by the* former being immovable, the

latter preternaturally moveable; by the want of crepitus in dislocation, and by the swelling, distortion, and alteration in the axis of the limb taking place at the joint, whereas in fracture they occur at some point along the shaft.

64. Dislocations *from disease* do not admit of reduction, but are considered to terminate most favourably when a false joint is formed.

65. The most recent dislocations are least severe, admitting of more easy reduction; if the bones continue unreduced, lymph is thrown out around the articular surfaces, which is first converted into a ligamentous, then into a bony socket—the former cavity is gradually obliterated by absorption, and a new joint, possessing considerable motion, is established.

66. Dislocations of the shoulder or hip can seldom be reduced after three months; those of ginglymoid joints generally become irreducible after a month; in persons of a relaxed habit this rule need not always be observed, but mischief is caused by attempts to reduce after these periods, in muscular persons.

67. In recent dislocations, the return of the bone to its socket is generally distinctly *audible*, but in old instances such is not the case.

68. When the accident is complicated, it becomes necessary *first* to reduce the dislocation, *afterwards* the fracture; fortunately, however, these accidents are rare.

69. Compound dislocations most generally occ at the ankle, elbow, and wrist; they are frequently attended with much danger, being followed by inflammation, suppuration, and in some instances by mortification and death. Amputation may be necessary, and the rules for its performance are similar to those given for fractures (18); an escape of synovia indicates a wound of a joint, and is known by the oozing out of oily globules. *Tetanus* sometimes follows compound dislocation, and when such is the case, death ensues; but in most other instances, provided a strictly antiphlogistic plan of treatment is followed, these accidents terminate favourably.

69 *bis*. *Rheumatic affections* are *acute* and *chronic*, swelling, acute pain, increased temperature, redness of joint, fever and general symptoms of acute rheumatism. *Chronic Rheumatic Arthritis*, characterized by peculiar changes in articular cartilages, alteration in shape of joint; *porcellaneous* deposit and crepitus.

70. Sometimes *deposits of bone* fill up the articular cavity and cause *anchylosis*, but at others there is some slight motion left, the deposit being of a ligamentous nature. Care must be taken that, when anchylosis is expected, the limb be placed in the most favourable position for use.

71. In the *treatment* of dislocations, it must be remembered that the bones are entirely passive, the surrounding muscles offering the principal impediment to the reduction, as is shown by the *ease with which* replacement of the bones is

effected when the spasmodic action has been reduced by chloroform, warm baths, or tartar-emetic, or when the attention of the patient is diverted at the moment of attempting the reduction.

72. The means adopted to replace the bones are, *counter-extension* and *extension:* the first is effected by fixing the limb above the dislocation with towels, or powerful bandages, fastened to the bedpost or wall; the latter, by making extension so as to bring the head towards the articular cavity.

That this extension may be firm, steady, and gradual, the pulleys should be used.

The limb must be placed in such a position as to relax the principal muscles, and, according to the practice of English surgeons, the extension made from the lower part of the dislocated bone.

After the reduction, the parts should be kept in such a position, by bandages, splints, and quiet, as to prevent a renewal of the displacement, to give time for the subsidence of inflammation, and for the parts to regain their elasticity.

CHAPTER IV.

ON PARTICULAR JOINTS.

73. The bodies of the vertebræ are connected *by—1st, Ligamentum* commune anterius, whi

consisting of longitudinal fibres, extends from the axis to the sacrum, along the anterior aspect of the bodies of the vertebræ; it is arranged in layers, the superficial passing from a vertebra to the fourth or fifth beneath, the deep only from one to the next; it expands on the side of the vertebra, to which it adheres closely, and is widest in the lumbar region; 2nd, *Ligamentum commune posterius*, extending from the same bones as the preceding, is broadest opposite the intervertebral substances; at its upper part it is continuous with the occipito-axoidean ligament and dura mater, and is wider above than below; 3rd, *Intervertebral fibro-cartilages*, which are arranged in fibrous layers, most dense at the circumference, nearly fluid in the centre, thickest at the lower part of the spine, and deeper in front, where the convexity is forward. Between the *articular processes* are capsular ligaments and synovial membranes, and between the *laminæ*, the *ligamenta subflava*, named from their yellow colour, of very strong and elastic structure, and most dense in the loins. The *inter-spinous* ligaments exist only in the back and lumbar region; the *inter-transverse* only from the fifth to the eleventh dorsal.

74. The *atlas* and *occiput* are connected by—1st, *Capsular ligaments*, extending from around the condyles to the superior articulating surfaces of the atlas; 2nd, *Anterior* and *posterior occipito-atlantal* ligaments of a broad and membranous nature, which attach the margins of the foramen

magnum to the upper surfaces of the atlas, and are divided above by the condyles, below by the articulating processes of the atlas. Extending across from one articulating surface of the atlas to the other, is the *transverse ligament*, which separates the foramen of the atlas into two unequal parts, through the smaller of which passes the odontoid process, through the other the spinal marrow and membranes.

75. The axis and occiput are connected by the *two ligamenta alaria*, which pass from small fossæ on the inner and exterior side of each condyle, to the sides of the odontoid process, close to the apex. The atlas and axis have capsular ligaments around their articulations, enclosing synovial membranes; a similar membrane between the body and odontoid process, and another between the latter and transverse ligament; also two *atlo-axoid* ligaments, extending from the lower border of the rim of the atlas to the body and laminæ of the axis.

76. At the anterior part of the foramen magnum, the dura mater divides into two layers, one of which forms the *theca vertebralis*, whilst the other passes down behind the transverse ligament, forming the posterior occipito-axoidean ligament, and is connected to the ligamentum commune posterius; this, with the transverse ligament, forms the *crucial ligaments.*

77. *The ribs* are articulated to the dorsal vertebræ by—1st, *A stellate ligament*, extending from *the head of a rib* to the bodies of two vertebræ

and intervertebral substance; 2nd, *An interarticular ligament,* which extends from a ridge on the head of a rib to the intervertebral substance, and has, on each side, a distinct synovial membrane; 3rd, *An anterior costo-transverse ligament,* passing from the neck of a rib to the lower margin of the transverse process of the vertebra above; 4th, *Posterior costo-transverse,* passing from posterior surface of each transverse process to the tubercle of the ribs; 5th, *Middle costo-transverse,* connecting the neck to transverse process, and only seen on sawing across these bones. Between the tubercles and transverse processes there are two synovial sacs, separated by the interarticular ligament.

78. The first rib and half of the second are attached to the first dorsal vertebra; whilst the tenth, eleventh, and twelfth are each attached to the bodies of the tenth, eleventh, and twelfth dorsal vertebræ.

79. The diseases which attack the vertebral column are, *caries, psoas,* and *lumbar abscess, curvatures.* The injuries are, *fractures, dislocations, concussion, compression,* and *extravasations of blood or other fluids.*

80. *Caries* frequently occurs to the spongy structure of the bodies; it is indicated by dull pain, increased on striking the part, paralysis of the lower extremities, and formation of abscesses, either at the lumbar region, or in the groin, constituting lumbar, or psoas abscess; curvature of

the spine follows after some time, which may be angular or lateral, according to the portion of the body destroyed. This disease may commence in the bodies or intervertebral substances, and may arise either from scrofula, syphilis, or constitutional causes. *Rest, issues, caustic, moxas,* or *other counter-irritants,* prove most beneficial; if the cause is of a specific nature, remedies adapted to that disease—if constitutional, general tonics are most beneficial.

81. *Lumbar* or *psoas abscess* is indicated by the pointing of matter, either in the loins or in the groin, and which has passed along the sheath of the muscle, from which it is named. These diseases are very slow in progress, and have the same symptoms as caries, from which they generally arise, with the addition of hectic fever, and great emaciation. *Psoas abscess* has been mistaken for *femoral* hernia, but may be distinguished by its situation being external to the femoral artery, by its recession in the recumbent posture, by its being attended with hectic fever, fluctuation, some degree of redness, and by its following spinal disease; it may be distinguished from *inguinal hernia* by its being below Poupart's ligament.

The *treatment* is that mentioned for caries, and opening the abscess when the matter is near the surface; this is done for the purpose of relieving the distended cyst, and causing contraction of it; care must be taken to open it by a small and *valvular* orifice, as the admission of air causes putrefaction and a typhoid condition. Cases of cure sometimes happen, but in general psoas abscess terminates fatally. Cases frequently do well treated antiseptically.

82. *Concussion* and *compression* of *spinal cord* are shown—by paraplegia, or paralysis of the parts below the seat of the injury, dyspnœa, involuntary evacuation of fæces, and retention of urine; in *concussion*, these symptoms come on *suddenly*, in *compression*, *gradually;* they may terminate in partial paraplegia, but, in general, death ensues either from inflammation and ramollissement, disease of mucous surface of bladder, or without any discoverable lesion. General and local bleeding, rest, and counter-irritation, are the remedies indicated.

83. *Fractures of the spine* do not occur without great violence; they are, in general, more or less transverse across the body, are attended with displacement of the bones, and pressure on the medulla spinalis, but rarely with any separation of the intervertebral substances; there is also loss of power and motion in all parts supplied by those nerves which are given off below the seat of the injury.

84. When any of the *lumbar vertebræ* are displaced, there is paralysis of the legs, erection of the penis, involuntary passage of fæces from paralysis of the sphincter ani, retention of urine from a paralysed state of bladder, and formation of *ammonia, which* is caused by the nitrogen of the urine

absorbing hydrogen whilst remaining in the bladder. In such cases death ensues in about six weeks.

85. If a *dorsal* vertebra is the seat of injury, there is, in addition to the above symptoms, a tympanitic state of bowels, and loss of feeling, as high as the fracture. Death generally follows in two or three weeks.

86. *Displacement of a cervical vertebra* below the fourth or origin of *phrenic* nerve, causes paralysis of upper and lower extremities, of the abdominal and pelvic viscera, but not of the diaphragm; if the injury be in an oblique direction, the paralysis of the upper limbs may not be complete, but a fatal result follows in three or four days.

87. When the *fracture* is above the origin of the *phrenic*, the action of the diaphragm is arrested, and death ensues within twenty-four hours.

88. The *treatment* for these accidents is generally palliative; rest, drawing off the water, removal of any irritating cause, and attention to position and the state of the bowels, are the means of relief usually adopted. Where the bones are displaced, reduction should be effected if possible.

89. *Dislocations* occur between the *first and second cervical vertebræ*, either from violence forcing the odontoid process from its situation, or from disease of the transverse ligament; when such is the case, pressure is made on the spinal marrow, the head falls forward, and death ensues directly.

No dislocations occur at other parts without fracture of the articulating processes.

90. *Lateral* curvatures of the spine arise from

disease of the vertebræ, from over-action of the muscles of either side, from softening of the bones, or from any cause likely to produce debility, as the wearing of tight stays, sedentary occupations, or the want of air and exercise. A projection of one shoulder is noticed, and, upon examination, a curvature of the spine is observed, generally inclining to the healthy side, in consequence of the greater tone of the muscles of that side. Sometimes, also, a slight degree of paralysis accompanies the curvature, and is present even above the seat of the disease.

Attention to the general health, air, exercise, counter-irritation, and rest, are the most likely means of cure.

91. *Fractures* rarely occur in the first or the last three ribs, the former being protected by the clavicle, the latter being moveable. The best mode of detecting fracture of these bones, is by placing the flat hand upon the ribs, and causing the patient to inspire, or cough, when *crepitus* may be felt. An excellent method of discovering fracture is to percuss the sternum from above downwards, when the seat of injury will be indicated immediately a tap is made opposite the articulation of the fractured rib with it. A broad bandage or broad strong strapping tightly placed round the thorax causes breathing to be carried on by the diaphragm and abdominal muscles, and keeps the ribs in one position; when dyspnœa, cough, and expectoration of blood are present, active depletion is necessary.

92. Dislocations of the ribs rarely occur without fractures of the vertebræ, and when such is the case, are generally fatal.

93. *Emphysema* or collection of air in the cellular tissue covering the ribs, or between the air cells, is caused by a wound through the pleura. Best treatment, firm bandage over broken rib to stop effusion of air into cellular tissue. When the air collects in the cavity of the pleura, it is called *pneumothorax*, in which case, if breathing be very difficult, the air may be let out by passing a small trocar between fifth and sixth ribs.

94. The *sterno-clavicular articulation* is formed by a triangular surface on the upper angle of the sternum, looking upwards, outwards, and backwards, and by a corresponding-shaped articulation on the clavicle. The *ligaments* are anterior, posterior, superior, or inter-clavicular, and an inferior or rhomboid attached below to the first rib. In the joint is a distinct *interarticular fibro-cartilage*, nearly circular in form, attached above to the clavicle, and below to the union of the sternum with the first rib; on each side of this cartilage are distinct *synovial membranes*, which occasionally communicate through an aperture in the cartilage.

95. *Dislocations* seldom take place at this joint, but they may occur either forwards, upwards, or backwards; the former most frequently; most common in children.

In all three kinds the distance from the shoulder *to the* breast is lessened; when forwards, the sternal end of the clavicle is felt on the sternum; when *upwards*, the distance between the two clavicles is diminished, and when *backwards*, there is great difficulty of swallowing, from pressure on the œsophagus.

The treatment consists in keeping the shoulders back, either with a figure-of-eight bandage, or by an apparatus invented for the purpose, and a pad in the axilla.

96. The *acromio-clavicular articulation* is formed by a smooth oval surface on the acromion process looking inwards, and by a corresponding one on the extremity of the clavicle, by a very thin *interarticular fibro-cartilage, two synovial membranes,* and a *superior* and *inferior ligament.* Besides these there are two ligaments attaching the clavicle to the coracoid process, of which the posterior one, called *conoid,* has its base directed upwards, whilst the other, *the trapezoid,* is longest, broadest, and most external. The clavicle is further connected to the upper surface of the first rib by the costo-clavicular ligament or ligamentum bicorne.

97. *Dislocations* at this joint are with difficulty retained in position when reduced, but offer little impediment to the motion of the arm.

98. *Fractures of the clavicle* are frequent, the bone being much exposed, and having the whole weight of the arm attached to it; they are most common in the middle part of the bone. The sternal end remains fixed in consequence of the *muscles and ligaments* attached to it, whilst the *scapular end is* drawn downwards and inwards

under the fixed portion; the distance from the shoulder to the breast is diminished: the hand cannot be raised, the humerus having no fixed point to act from, and crepitus may be felt.

The treatment consists in raising the shoulder by placing a pad in the axilla, and in keeping it drawn backwards by applying a figure-of-eight bandage, or the apparatus mentioned for fractures of the same bone.

SHOULDER-JOINT.

99. *The shoulder-joint.*—This joint is one of the orbicular kind, and is formed by the globular head of the humerus, and the shallow pyriform glenoid fossa of the scapula; it is protected above by the acromion and coracoid process with the *coraco-acromial* ligament extending from one to the other; although the glenoid fossa is deepened by the glenoid ligament, it is very shallow, and is only kept from more frequent dislocation by the very free motion of the scapula, and by the large rounded head of the humerus offering an articulating surface to the joint in whatever position the arm is placed.

The principal ligament is the *capsular*, of a conical shape, strong above, where the capsular muscles are attached, and in front, where it is called *coraco-humeral;* but very weak below, and offering but little impediment to displacement in that direction. The tendon of the biceps, which *is internal* to it, and external to the synovial membrane, acts as a ligament above, and the tendon of the triceps protects the joint below. When the muscles are removed the humerus falls away from the glenoid fossa more than an inch, and is only retained in apposition by the capsular and other muscles. The *synovial membrane* forms a tube round the tendon of the biceps, and passes down the bicipital groove for more than an inch.

100. *Dislocations* of this joint are very important, and require to be thoroughly understood; they are *forward, backward, downward,* and *partial,* or on to the margin of the glenoid fossa. The shape of the joint should be compared with the sound one, as cases sometimes happen where many of the usual symptoms are wanting.

In that *downward,* into the axilla, the limb is *lengthened;* there is a *depression* beneath the acromion process; the elbow is *thrown out* from the side, and cannot be *brought down;* the forearm is *bent,* and in general the hand is *supported* by the patient; the limb is *numb* and *painful,* and on raising the arm the *head* of the humerus is felt in the *axilla.* Sir Astley Cooper's mode of reducing this dislocation consists in placing the *foot* in the axilla, and then making extension on the forearm, which extension should be combined with adduction towards the middle line of the body, by which means the head of the bone is carried into its cavity; the other modes adopted are—by making *extension* at *right* angles to the *body with pulleys* or assistants, and then raising the head—by *bending* the arm over the *knee*—and sometimes even by *raising the forearm* till the body is almost suspended by it, and then pushing the head of the bone into its socket.

In that *forwards* the arm is *shortened* and *fixed*, the elbow thrown backwards and from the side, the flatness beneath the acromion process is very considerable, and the head of the bone is felt under the pectoralis muscle, and below the clavicle. Extension downwards and backwards is required for its reduction; by attending to this direction the coracoid process is avoided.

In that *backward* the elbow is thrown forward, the head of the bone is felt beneath the spine of the scapula, and the limb is shortened, fixed, and thrown out from the side. Extension must be made forward and downward.

In the *partial* or incomplete kind, the head of the humerus rests against the coracoid process, and may be felt grating on it; there is also a depression behind, and the limb is fixed. After reducing these dislocations, it is necessary to support the limb in a sling for a few days, taking care that it is placed *over the elbow*, in contradistinction to that used in fracture of the humerus, which is made to avoid it; if the subscapularis is ruptured, or the head of the humerus has passed through the capsular ligament, the reduction becomes more difficult. Chloroform should be given when possible.

101. *Fractures* of the *neck* of the scapula, of

the *acromion process*, of the *neck of the humerus*, and of the *coracoid process*, may be mistaken for dislocation, especially the first three. When the *neck of the scapula* is broken off, the arm is lengthened, and hangs loose by the side; there is preternatural motion, and considerable depression beneath the acromion process; on raising the humerus the form of the joint is restored, but on relaxing hold the limb again drops, and crepitus is felt; it may be distinguished from dislocation downwards by its great mobility, by the crepitus, by the forearm hanging loose and straight down, and by the ease with which the arm is raised.

102. *A fracture of the acromion process* cannot easily be mistaken for a dislocation, as the length of the limb remains the same, and the irregularity in the acromion process may readily be detected. In this accident the arm and forearm must be supported by a sling, and bound to the side.

103. The *surgical neck* of the *humerus*, which is below the tubercles, may be broken off, but the *shortening of the limb*, the *crepitus*, and the *rotundity of the joint continuing*, distinguish it from dislocation: the shaft of the bone may be drawn into the axilla in this accident, but it would readily be felt there. Splints, a pad in the axilla, and a sling to support the arm, are requisite for its treatment.

104. *Fracture* of the *coracoid process* is detected by the crepitus which is felt on pressing *between the* anterior edge of deltoid and outer

edge of pectoralis major, and by the difficulty in raising the arm upwards and forwards, in consequence of the detachment of the origins of the coraco-brachialis and biceps muscles. In this, as also in some of the other fractures at this joint, there is great difficulty in obtaining bony union from the motions of the thorax tending to displace the bones.

ELBOW-JOINT.

105. The *elbow-joint* is formed by a portion of the lower extremity of the humerus, called the trochlea; by the greater sigmoid cavity of the ulna; by the round head of the radius, and by five ligaments, which are the *internal lateral*, extending from inner condyle to the olecranon and coronoid processes; 2nd, the *external lateral* attached above to the external condyle, below to 3rd, the *coronary*, which surrounds the *head* of the radius; 4th, an *anterior* not very distinct, but extending from anterior margin of the trochlea to the coronoid process, and 5th, a *posterior*, which is extended across from one condyle to the other; this joint is lined by a synovial membrane, but has no capsular ligament. The radius and ulna are attached by an *interosseous* membrane, and by an *oblique ligament*, which extends from the coronoid process to the radius below the tubercle, is separated from the interosseous membrane by the artery of the same name, and has its fibres *passing in a* different direction.

106. This joint is one of the ginglymoid kind, and is subject to dislocation of *both bones backward*—of the *radius alone, either forward or backward*—and of *partial dislocations*, either externally or internally. The most frequent is the dislocation *backward*, and is known by shortening of the forearm, by the sharp projection of the olecranon, by the half-bent state of the forearm, by the immobility of the limb, and by the condyles being felt on the front of the forearm. In dislocation of the *radius backward*, the forearm is bent, and the hand fixed in a state of pronation; the hand and fingers are also bent, and the head of the bone is felt protruding behind. In the dislocation of this *bone forward*, the forearm is slightly bent, but cannot be brought to a right angle with the arm; the hand is pronated; the coronary, oblique, capsular, and interosseous ligaments are torn, and the forearm cannot be extended.

Dislocation of the *ulna forward* cannot occur without fracture of the olecranon; and those *laterally* are only partial, and are attended with great violence.

Extension of the forearm, and flexion over the knee, are in general sufficient to reduce these injuries.

107. Fractures of the lower extremity of the humerus somewhat resemble dislocation of both bones backward, but are distinguished by the *crepitus, and by the* ease with which they are

replaced. When the condyles are broken off, they are drawn down by the muscles, and give an appearance of shortening of the forearm, but may be detected in a similar way to the preceding; an angular splint, bandages, and the support of a sling, are necessary for its cure, and after two or three weeks, passive motion must be resorted to, to prevent anchylosis.

108. *Fractures of the olecranon* are usually in a transverse direction, and about the centre; the forearm is half bent from the action of the brachialis anticus and biceps; the olecranon process is drawn up by the triceps, but does not separate very far from the shaft, in consequence of the attachment of the ligaments; the power of extending the forearm is usually lost; there is crepitus on making extension, and a depression felt at the back of the joint. To effect a cure, the forearm is kept nearly extended; bandages are placed both on the arm and forearm, to prevent muscular contraction; a splint is placed on the front of the joint, and a figure-of-eight bandage is then fixed over the broken bone. Passive motion must be resorted to in this case in three weeks or a month. However quiet the limb is kept, bony union does not take place either in this fracture or in that of the condyles, and an interval is observed between the fractured ends of the bones, which is filled up by ligament.

109. The *wrist-joint*, which is formed by the *lower* extremity of the radius, by the lower sur-

face of the triangular fibro-cartilage, and by the convex surfaces of the scaphoid, semilunar, and cuneiform bones, is an *arthrodia.* There are four ligaments, a triangular fibro-cartilage, and two synovial membranes, one of which is situated above the cartilage; but there is no capsular ligament.

110. There are five *synovial membranes* situated in the carpus and metacarpus—viz, the two above mentioned; one between the trapezium and metacarpal bone of the thumb; a fourth between the pisiform and cuneiform bones; and between the two rows of metacarpal bones a fifth, which is separated from the true synovial membrane of the wrist-joint by the interosseous ligaments, but after passing between the second row, extends between the carpus and metacarpus.

In front of the carpal bones is the anterior annular ligament, extending from the scaphoid and trapezium to the pisiform and cuneiform bones, *through* which passes the flexor carpi radialis, *beneath* it the flexor digitorum sublimis and profundus, flexor longus pollicis, median nerve, and interosseous artery, comes nervi mediani, bursal tissue of tendons; whilst *superficial* to it are the ulnar nerve and artery, superficialis volæ, and tendons of flexor carpi ulnaris, palmaris longus and brevis, the last three terminating upon it.

111. *Dislocations* occur either *backward* or *forward,* at the wrist, but when the bones are *thrown to either side,* only partial displacement

takes place. In the luxation *forward*, there is a tumour on the palm of the hand, which is bent backwards, and fixed; in that *backward*, the tumour is felt on the dorsum of the carpus, and the hand is bent.

Extension, cooling anodyne lotions, and splints are necessary.

Severe sprains sometimes assume the appearance of dislocations, but in them the swelling does not come on directly after the accident, and is single.

112. *Fractures of the radius* are accompanied by loss of power of pronation and supination, by falling of the wrist towards the ulnar side, and by the upper head of the bone remaining stationary when the lower end is rotated, at which time, also, crepitus is usually felt. Where the lower third of the bone is fractured (*Colles' fracture*) liable to be mistaken for dislocation. All deformity in *fracture* reduced by making extension, which recurs when the traction is removed—the styloid process moves with the hand in fracture but not in dislocation.

Treatment by extension, by pistol splint, or, still better, straight anterior splint to middle of palm and back splint to dorsum of wrist; or by Gordon's splint.

113. *Fractures* may occur in the carpus, metacarpus, or in the phalanges; they must be treated, in the first instance, by lotions, and afterwards by pasteboard splints; or by a round ball, placed in the *hollow* hand, and secured there by bandage.

114. The *phalanges* are united by an *anterior* and two *lateral ligaments*, which it is particularly necessary to remember, either in reducing dislocations or in amputating fingers.

A dislocation of the *os magnum* happens sometimes in relaxed habits, and may be mistaken for a ganglion; the latter may, however, be known by its elasticity.

CHAPTER V.

ON PARTICULAR JOINTS.

115. THE *hip-joint*, formed by the globular head of the femur, and the deep circular cavity of the acetabulum, affords the best specimen of an *enarthrodial* articulation. Both surfaces are covered by cartilage, of which that on the femur is thickest on the summit, that in the acetabulum at the circumference; the latter cavity is separated in the fœtus into three parts, and is formed by one-fifth of the os pubis, rather less than two-fifths of the os ilium, and rather more than two-fifths of os ischium; after birth, these bones become united, but the cavity remains deficient at the lower and anterior part, which is called the notch, and is for the passage of a branch of the internal circumflex and obturator arteries to the joint; a rough depression is observed, also, at the lower part, into which is attached the ligamentum teres, and where is found the so-called

"gland" of *Havers,* which is simply a pad of fat and synovial membrane, serving as a nidus for vessels and as a buffer.

The acetabulum is rendered still deeper by the *cotyloid* ligament which surrounds it, and which passes across the notch, where it takes the name of the transverse ligament; to a triangular surface on the summit of the head of the femur is attached the outer extremity of the round ligament; and surrounding the joint, from the neck of the femur to the margin of the acetabulum, is the *capsular ligament,* much more dense in that portion which is stretched between the anterior-inferior spine of the ilium, and the lesser trochanter, and which is called the *ilio-femoral ligament* or Y-ligament of Bigelow. Within the capsular ligament is a synovial membrane, which is reflected from one surface of bone along the ligamentum teres on to the other; and around it, in immediate contact, are the following muscles—viz., *rectus femoris, iliacus,* and *psoas magnus, pectineus, obturator externus, gemellus inferior, obturator internus, gemellus superior, pyriformis,* and *gluteus minimus.*

Scrofula (59), *caries, rheumatism,* and *synovitis,* attack this joint, and *dislocations* and *fractures* are not unfrequent.

116. The head of the femur may be dislocated *in four ways :—*

1st, On to the dorsum of the ilium, when the *following* are the symptoms—shortening, from inch and a half to two inches, *inversion* and *immobility*, *loss of prominence of great trochanter*, *toes resting on instep* of opposite foot, *knee bent*, and thrown forward and inward, and *general flattening* of muscles over the joint.

The pelvis having been fixed, extension should be made in the direction in which the limb lies, that is, downwards, forwards, and inwards. Great resistance to the reduction is offered by the muscles, pulleys and chloroform are therefore essential; bleeding is useful when the patient is of a plethoric habit. The *flexion* method frequently ol use. The knee should be bent on the thigh and the thigh on the pelvis, the ankle grasped with one hand and the knee with the other, causing the thigh to make a circular movement of abduction, finishing with a slight rotatory movement, or shortly, *Lift up, Bend out, Roll out.*

2nd, *Into the sciatic notch*, which might be mistaken for the former, but is distinguished—by *slighter shortening*, by *the numbness* and *pain in the leg*, caused by pressure on the nerves and vessels, by *the great toe resting on the same toe of opposite foot, and by the great trochanter being removed further from the spine.* Surgeons consider this dislocation most difficult to reduce, from its deep situation behind the acetabulum; extension *is to* be made across the opposite thigh, at *the same time* raising the head from the sciatic *notch by a towel* placed beneath the trochanter *minor.*

3rd, *Into the obturator foramen* when the limb is—*elongated, abducted, slightly everted, thrown forward*, and *fixed;* there is also loss of *rotundity at the joint, inclination of the body to that side*, and *forward*, and *the ball of the toe rests on the ground.* The *globular head* of the *femur* may also *be felt in a thin person*, at the upper and inner part of the thigh. This dislocation is next in frequency to that on the dorsum ilii, and is attended frequently with rupture of the pectineus and adductor-brevis muscles, but not necessarily of the ligamentum teres.

It is easy of reduction, and this is effected by first making slight extension downwards and outwards, then raising the head of the bone by towels round the neck, and bringing the foot towards the opposite limb. Great care is necessary to prevent the head of the bone slipping backwards into the sciatic notch, whence it will be difficult to remove it.

4th, *On to the pubis*, when the following are the symptoms:—considerable *shortening*, of more than an inch, *rotation outwards, immobility*, and *abduction of the limb*, the *knee bent*, the *head of the bone felt on pubis*, the *distance* between the great trochanter and anterior-superior spine of ilium *diminished*, and great *pain* and *numbness.* Extension must be made downwards, outwards, *and rather* backwards, at the same time raising *the head; if* the extension be too great, the head *may be* carried into the obturator foramen.

117. In considering *fractures* at the *neck of the femur*, it is necessary to remember that the *angle*, formed by its neck and shaft, is *obtuse* in *manhood*, becomes more of a *right angle* in *old age*, and that the head then sinks below the level of the great trochanter; also, that a disease, called *interstitial absorption*, causes *shortening* of the neck, cases of which, on post-mortem examination, have been mistaken for fracture healed by osseous matter. Fractures of this part are most frequent in old age, in consequence of the tendency to ossific deposit at that period (5), and of the above-mentioned interstitial absorption; when they occur under the age of fifty, the injury is generally found to be external to the capsule; they are also more frequent in females, since, from the greater breadth of the pelvis, the angle is more acute.

The symptoms are—*shortening* of more than an inch; *preternatural mobility;* and *considerable eversion of the limb*, which hangs down by the side; *all power of motion by the patient is lost; crepitus* is felt on rotating and drawing down the limb, which may be brought to the same length as the opposite, but returns again to its position on removing the extension; there is also *loss of prominence* of great trochanter, and *flattening* at the joint.

Several different plans are adopted for the cure of this injury, such as fracture-boxes, fastening the two limbs together, attaching weights to the foot, *nd Desault's splint*, which last is the preferable plan; this splint extends from os ilium to foot, and keeps the parts in position, whilst it allows of the patient moving.

In the *fracture* which extends to the *outside* of the capsular ligament, ossific union sometimes takes place; in that within, it never does, and the reasons are—1st, *the difficulty of keeping the parts in apposition;* 2nd, *the deficiency of periosteum;* 3rd, *the age of the patient*, fractures rarely occurring in youth, or dislocations in old age; 4th, *the sparing supply of blood* through the parts within the joint.

The fracture within the capsule may be mistaken for dislocation on the pubis, as shortening of the limb, eversion, and flatness of the joint, are present in both, but the diagnosis is as follows: in fracture there is *preternatural mobility*, in dislocation, *immobility;* in the former, the limb may be *brought down to the level of the opposite one*, in dislocation, *it cannot;* in fracture, *the knee is straight*, in dislocation, *it is bent;* in fracture, there is *crepitus*, in dislocation, *none.*

KNEE-JOINT.

118. The *knee-joint*, which is an angular ginglymus, is formed by the two condyles of the femur, by the head of the tibia, and by the posterior part of the patella. The true ligaments are in number seven, of which four are external to *the articulation*, and three described as internal;

the external are — 1st, *Ligamentum patellæ*, which, although it answers the purpose of a ligament, is, in truth, nothing more than the tendon of the quadriceps extensor femoris, having the patella placed within it in a similar manner to the sesamoid bones, and being attached below to the tuberosity on the tibia.

2nd, *Ligamentum laterale internum*, extending from internal condyle of femur to inner edge of the head of tibia, and semilunar cartilage.

3rd, *Ligamentum laterale externum*, attached above to a tuberosity on the external condyle of femur, and splitting into two portions, is connected below to the head fibula and deep fascia of leg; within it are placed the tendon of the popliteus muscle, and external articular artery; and between the two portions of the ligament is tendon of the biceps muscle. 4th, *Ligamentum posticum Winslowi*, passing upwards from inner tuberosity of tibia to back part of the outer condyle of femur, forms one of the insertions of the semi-membranosus muscle, and gives passage to the azygos artery, vein, and articular branch of obturator nerve. The internal ligaments are— 1st, *Ligamentum cruciale anterius*, which extends from inner part of external condyle to anterior part of spine of tibia. 2nd, *Ligamentum cruciale posterius*, which extends in nearly a vertical direction from the outer and fore part of inner condyle to posterior part of spine of tibia, and external semilunar cartilage. These two ligaments, *although* called internal, are situated external to the synovial membrane. 3rd, *Ligamentum transversale,* which, small and sometimes wanting, connects the semilunar cartilages in front.

The semilunar fibro-cartilages, two in number, are placed upon the head of the tibia, and consist of concentric fibres, which are thickest at the circumference; the internal one, of an oval shape, is attached to the internal lateral ligament, whilst the external, which is nearly circular, is separated from the external lateral by the external articular artery, it is connected anteriorly to the transverse, and posteriorly to the posterior-crucial ligaments; they are concave on their superior surfaces, level on the inferior. Folds of synovial membrane within the joint have been called *ligamenta alaria*, and *mucosa.*

The bones forming this articulation are covered by cartilage, and lined by synovial membrane, which, after investing them, is reflected over the semilunar cartilages and round the crucial ligaments.

From the obliquity of the femur it is evident that the internal condyle projects most inferiorly; but the external is the largest, and its anterior surface, which proceeds higher up the front of condyle, is in relation with the outer and larger surface of patella. Between the ligamentum patellæ and tuberosity of the tibia is a large bursa mucosa, in dissection liable to be mistaken for the *synovial membrane*; and covering the joint is an aponeurosis from the quadriceps extensor, but no capsular ligament. The synovial membrane extends upwards under the quadriceps extensor for about four inches.

119. Dislocations of the tibia and femur take place—forwards, backwards, or to either side, but from the large surfaces in contact, they are mostly partial, and caused only by great violence.

The patella may be dislocated either *inwards* or *outwards*, and, when the ligament is *ruptured*, upwards. The one *inwards* is rare; whilst that *outwards* is more common, especially in those whose knees incline inwards; both these accidents are known by *flattening of the joint* in front, *protuberance* either on the inner or outer condyle, and *loss of power of flexion.* Reduction is effected by extending the limb, for the purpose of relaxing the extensor muscle, and then pressing the outer and free margin of the patella; where any difficulty is found in thus reducing it, sudden flexion may be tried.

120. *Fractures* of the *patella* are either transverse or longitudinal: the former, which is most frequent, occurs from violent action of muscles, the latter from direct violence; loss of power of extension, and a groove felt across the patella, indicate this accident. *Ligamentous union* takes place in almost all such cases—but where the parts have been kept *in close apposition* for five or six weeks, *bony union* has occasionally followed. Straight *back splints,* figure-of-eight bandage over frag-

ments, foot raised, thigh slightly flexed on pelvis, Malgaigne's hooks.

121. When a fracture, either of the condyles of femur or head of tibia extending into the joint, occurs, the limb should be kept extended; but when the fracture takes place just above or below the joint, a double inclined plane is preferable, as deformity is sure to follow the extended position; care must be taken to keep the great toe in a line with the patella in all fractures of the legs. Luxations of the semilunar cartilages sometimes take place, and are known by the sudden loss of power by the patient, whilst the limb can easily be moved by the surgeon.

ANKLE-JOINT.

122. The *ankle-joint* is a ginglymus, and is formed by three bones—viz., lower extremity of tibia, which articulates with the inner and upper surface of astragalus, and the fibula, which articulates with the outer one on the astragalus. The upper surface of this last bone is convex from before backwards, and broadér anteriorly than behind; it is important to remember this in reducing a dislocation, for by keeping the foot extended, the dislocated surface diminishes in size, as extension brings the bone forward, and this greatly facilitates the reduction; the outer articulation of the astragalus is larger than the inner, and the anterior forms a ball-and-socket joint, with scaphoid bone;

the groove in the posterior part is for the passage of the tendon of flexor-longus-pollicis.

The ligaments connecting this joint are—1st, *the internal lateral*, or *deltoid*, which, above, is attached to internal malleolus, and below, where it is much extended, to the os calcis, astragalus, and sheath of flexor digitorum pedis. 2nd, *External lateral*, consisting of three portions which radiate from the malleolus; the anterior is attached to the fore part of the malleolus, and to the astragalus; the posterior extends from digital fossa behind the articulating surface on the fibula to the astragalus; the descending, from the tip of malleolus to the os calcis, which last portion is covered by the tendon of peroneus muscle. 3rd, *Anterior*, indistinct and resembling membrane, reaches from front of tibia to astragalus.

Between the tibia and fibula, along its whole extent, is the interosseous membrane, whilst these bones are united above and below by distinct ligaments; at the upper peroneo-tibial articulation is a synovial membrane and ligament; at the lower, the synovial membrane of the ankle-joint is common to it; and here these bones have an anterior and posterior ligament running across, the latter of which is very distinct, and materially assists in forming the joint.

There is one ***synovial membrane*** which alway contains much synovia, but no ***capsular ligamen to*** the ankle-joint.

128. The dislocations are—1st, that of the tibi and fibula *inwards*, which is indicated by the internal malleolus resting on the ground, by the sole of the foot looking outwards, and by a fracture of the fibula, about two inches above the joint; it is most frequent, and the broken fibula is well known by the name of *Pott's fracture;* next in frequency is, 2nd, that of the same bones, *outwards*, in which the external malleolus rests on the ground, or projects much, the foot is inverted, and sometimes the internal malleolus is broken; 3rd, that of tibia and fibula *forwards*, which is not very common, but may be known by shortening of the foot, and projection of the heel; 4th, that *backwards*, which is denied by many surgeons.

In reducing these dislocations, the muscles of the calf should be relaxed by bending the knee, and the ankle-joint extended, for the purpose mentioned above (122). Extension should then be made from the end of the foot, and a splint applied. In Pott's fracture, the limb should be laid on a splint placed along the fibula, the tibia acting as a splint on the inner side.

TARSAL AND METATARSAL JOINTS.

124. The bones of the tarsus, seven in number, are articulated by arthrodia, except between the astragalus and scaphoid. There are *dorsal* and *plantar* ligaments between the cuneiform, cuboid, and scaphoid, whilst the latter is connected to the os calcis by the *calcaneo scaphoid*, a powerful *elastic structure*, on which depends the preserva-

tion of the arch of the foot. Between the calcis and astragalus is the *strong interosseous ligament*, separating the articulation into two parts; and between the calcis and cuboid bones are two powerful *calcaneo-cuboid* ligaments; that on the under surface being the most powerful one in the foot, and forming a groove for the tendon of the peroneus longus.

There are seven synovial membranes found at this part—viz., one between the astragalus, tibia, and fibula; two between under surface of astragalus, os calcis, and scaphoid; one between os calcis and cuboid; one between scaphoid, three cuneiform, and second and third metatarsal bones; another between cuboid and fourth and fifth metatarsal; and one between internal cuneiform and metatarsal bone of great toe. The articulations between the metatarsal bones and phalanges resemble those of the hand, and suffer from the same diseases and accidents. Sometimes the *astragalus* is thrown forward on the *scaphoid*, and causes a tumour to be felt in that situation. There is great difficulty in effecting a reduction, and in some cases, removal of the bone has been found necessary.

THE ARTICULATION OF LOWER JAW.

125. Is formed by condyle of same bone, and *glenoid fossa* of temporal, constituting an *arthrodia* *joint*. The ligaments are—1. External, reaching from tuber-articulare to outer edge of the condyl 2. *Internal*, from spinous process on sphenoid

inferior margin of dental foramen. The internal maxillary artery with the middle meningeal and inferior dental branches, and the corresponding nerves, pass between this ligament and the bone; whilst its outer surface corresponds to the external pterygoid muscle. 3. *Stylo-maxillary*, which more resembles membrane than ligament. 4. *Pterygo-maxillary*, from pterygoid process to root of coronoid process, has attached to it anteriorly the buccinator, posteriorly the superior constrictor. There are two synovial membranes, and an inter-articular fibro-cartilage, which is concave, both above and below, and is connected to the external lateral ligament and external pterygoid muscle. Dislocations take place *anteriorly* or *laterally* :— in the *first*, which is complete, the jaw is thrown *forward, the mouth is wide open* and *fixed*, there is *inability to swallow, shown by the flow of saliva* from the mouth, and *depression behind the condyles* ; the *second* kind is *incomplete*, and is marked by lateral distortion. Reduction of these luxations is effected by putting either the thumbs, well protected, or two forks, as far back along the alveolary ridge as possible, pressing down the last molar teeth, and then raising the chin.

126. The bones of the pelvis are connected by synarthrodial joints between the sacrum and ilium, and by amphiarthrodia at the symphysis pubis. *The ligaments*, which are numerous, but in general *not very distinct*, will be treated of in the chapter *on that cavity*.

CHAPTER VI.

ON THE MUSCLES, BLOOD-VESSELS, AND ABSORBENTS.

127. THE muscles (μύειν, to contract) form the *active* organs of locomotion, and are divided into the *voluntary*, or those dependent on the will; the *involuntary*, or those uninfluenced by it in their action.

The *voluntary*, or *striated*.—In this, the ultimate striated muscular fibre, neither vessels or connective tissue enter; each fibre is enveloped in a sheath formed by a tough, elastic membrane, transparent and structureless, called *sarcolemma*. When the sarcolemma is torn, the contained fibre either divides into discs or breaks up into minute *fibrillæ*. In the heart the muscular fibres are striated, but have no sarcolemma.

Involuntary, or *non-striated* muscle, consists of elongated band-like fibres, each of which has a rod-like nucleus. The fibres do not break up into fibrillæ, and have no sarcolemma.

The muscles which are dependent on the will are supplied with nerves derived from the *cerebro-spinal system*, whilst those of the involuntary kind, which are principally found in the cavities of the body, have filaments of *the sympathetic nerve* plentifully distributed to them, and thence it is considered that this ganglionic system of nerves *presides over involuntary* action. When an impression is made on a muscle at any part which is supplied from the cerebro-spinal system, that impression is conveyed to the brain or spinal marrow by the *sensitive filaments* of the nerves, and the power of *volition* is then propagated to the part by the *motor filaments*, constituting what is called *the reflex action.*

Muscles possess a power of motion independent of the will, called *irritability*, which continues even after death, when any stimulus is applied. Tonicity is that power by which muscular fibre separates when cut.

Voluntary muscles being controlled and associated by the mind, it is by it that the various motions which require many muscles, and some coming from various parts, are regulated, and brought to combine in performing either extensive or limited actions.

The last effort of contractility in a muscle takes place in from one to eighteen hours after death, when stiffness of the body ensues; and this continues until the putrefactive process commences (*rigor mortis*).

Although muscles act from their origin or fixed point to their insertion, the fibres do not always run in that direction, but are inclined at an angle upon the tendon, as in the rectus femoris, the object of which seems to be for the purpose of increasing the number of filaments which are brought into action.

128. The chemical composition is principally *fibrine*, but there is also found albumen—gelatine

—*extractive matter—osmazome—phosphates of soda—ammonia,* and *lime*—and *carbonate of lime.* By treating this fibre with nitric acid, nitrogen gas is set free.

Blood-vessels are plentifully distributed to the *muscles; nerves* and *absorbents* are equally numerous.

129. This structure suffers from *inflammation* and its consequences, as formations of matter, the ulcerative process, or mortification; it may also be affected by paralysis, absorption, rupture, rheumatism, or morbid growths.

In voluntary muscles there is generally a sheath of investing cellular tissue (*fascia*), which also enters between the different bundles of fibres; this frequently gives rise to disease, which is erroneously attributed to the muscle; or it may afford passage to fluids, as in psoas abscess (81).

THE ARTERIES.

130. Arteries continue to diminish in size as they increase in distance from the heart, and terminate in small branches called *capillaries.* They have three coats, of which the external is *cellular,* the middle, *fibrous,* the internal, *serous.*

The *external* is possessed of great strength and toughness, and is divided with difficulty. The *middle one* is formed by circular fibres, partly of fibrous tissue, and partly of muscular fibre cells. In large arteries, the muscular tissue is only slightly developed; in those of medium size, more so; whilst in small arteries this coat is purely muscular, is easily ruptured, possessed of great elasticity, brittleness, and power of circular contraction. The *internal* consists of a layer pavement epithelium resting on a layer of longitudinal elastic fibre (*fenestrated membrane*).

131. When the stimulus of the blood does not affect an artery, its fibres gradually retract, and at length it terminates in a ligamentous cord.

The *internal* coat is similar in structure to the serous membranes, is smooth, polished, brittle, and continuous with the lining membrane of veins.

The arteries are surrounded by cellular tissue, which forms a sheath, and which is loosely united to them; it is through this membrane that the *vasa vasorum* pass, to supply the coats; and it is also in this tissue that the nerves and absorbents lie.

132. General inflammation rarely attacks arteries, but sometimes local arteritis does occur.

Wounds of these vessels continue to bleed if the calibre is only partly divided, and this is most profuse if the vessel is denuded of sheath; but where the size is small, complete division stops the flow, as in arresting hæmorrhage from the temporal artery. The blood flows in jets, and by this and its bright-red colour is distinguished from venous.

133. Small arteries, when cut, retract themselves into the surrounding cellular tissue, and by this and their circular contraction arrest the bleeding; but in larger vessels the greater impetus of blood overcomes this contraction, and prevents the formation of a clot.

134. When hæmorrhage has ceased in an artery, a clot forms in the interior, and another outside; this last is absorbed after some few days, and the artery contracts to its next collateral branch. A longitudinal wound will sometimes become closed by coagulable lymph, but if this be too weak to resist the impulse of the blood, a false aneurism forms.

135. In lacerated wounds, the arterial coats are ruptured irregularly, the external cellular being the longest;—into this the blood flows, and, becoming coagulated, puts a stop to hæmorrhage.

136. Various plans for stopping hæmorrhage have been adopted—viz., *actual cautery, cold styptics, pressure,* the *ligature,* and *torsion.*

The *actual cautery* is only applicable where a small vessel passes through a bone, and even then is seldom required. *Styptics* are of much use when the bleeding comes from the capillaries or vessels of small calibre, and of these, cold water, tinct. ferri perchlor. and lead lotions are the best.

Pressure is an important mode of stopping hæmorrhage, and where it can be adopted, without causing injury to the surrounding parts, should be used. A familiar instance of this is the tourniquet, which, however, from its general pressure, is only a temporary expedient until a ligature can be applied. Pressure is readily obtained by the *fingers (digital).*

137. *It is necessary* to apply a ligature *above,* another *below* a wounded artery, as secon-

dary hæmorrhage is liable to come on after some days, when the anastomosing vessels have increased in size, from the lower end of the vessel.

The immediate effect of a ligature is *division* of the two internal coats from which coagulable lymph is poured out, adhesive inflammation takes place, a clot of a conical shape is formed in the vessel, and the bleeding ceases, the part included in the ligature sloughs, and, after about fourteen days the external coats become separated by ulceration, and the ligature is set free.

Torsion, now frequently used, instead of the ligature, is performed by drawing the vessel from its sheath with a pair of broad-pointed spring forceps, and twisting it freely round (*unlimited torsion*); or by drawing out the vessel and fixing it with one pair of forceps about a quarter of an inch from the end, and then with another pair twisting the end round and round until it will not untwist itself (*limited torsion*).

138. A diseased state of artery will cause secondary hæmorrhage sometimes; or it may arise if the ligature has been applied too near a collateral branch; or if the surrounding cellular tissue has been separated, and the supply of blood to the coats diminished, producing ulceration, instead of adhesive inflammation. The best material for ligatures is well-waxed hempen twine, not too fine in texture, lest it cut through the external coats. As soon as the flow of blood through an artery is arrested, the anastomosing branches increase in size, and althoug

in the first instance the temperature and supply of blood to the part is diminished, a sufficient portion eventually finds its way to the limb.

ANEURISM.

139. An aneurism is a tumour, generally of a pulsating kind, formed by a dilatation or rupture of an artery, and containing blood.

There are two kinds—1st, *true;* 2nd, *false;* either of which may be external or internal.

1st, *A true one* is that where a portion of the calibre of an artery is only dilated, without lesion of the coats.

2nd, *A false one,* where rupture of the two internal, or sometimes of all the coats, has happened, and the blood has escaped, and its *sac* formed by surrounding tissues; if the aneurism be produced by disease, it is generally, in the first instance, a *true,* but becomes afterwards a *false* one.

The surrounding cellular tissue sometimes opposes much resistance to the escape of blood, when the aneurismal tumour becomes distinctly defined, and is then called *circumscribed;* but if the blood is able to pass along the coats for any distance, the limits are indistinct, and it is then called *diffused.*

140. The causes of aneurism are—1st, *atheromatous* or *calcareous deposit* in the coats, causing them to become weak and liable to rupture. 2nd, *The violence of the current of blood* in some of *the larger* arteries, as in the arch of the aorta.

3rd, *The weakness* produced by being situated near moveable joints. 5th, *External* injury.

141. Aneurisms are most frequent in men, and in them at the arch of the aorta; they rarely occur before the age of thirty. When produced by disease of the coats, they are often numerous, and situated in different parts of the body, and in such cases operations are useless, as the disease is constitutional.

142. *Symptoms* of an *external one* are—a *pulsating tumour*, which diminishes in size and ceases to pulsate when the trunk above is compressed; the *bruit de soufflet;* in a recent case the *tumour* may be almost entirely *removed* by *pressure above;* but in one of long standing the *deposits of coagula* prevent this; there is also swelling of the limb below, pain, and difficulty of motion.

143. If the pulsating tumour is caused by an enlarged gland being situated either below or superficial to an artery, it may be distinguished *from aneurism* by the facility with which the vessel may be pushed to one side without removing the tumour.

An exostosis or any enlargement of bone, a tumour, or any foreign body, as a bullet, situated beneath a vessel, may also be taken for aneurism, but may be distinguished in the same way.

144. The symptoms of internal aneurism are obscure, and vary, at whatever part of the body they are placed:—there is frequent disposition to *syncope:* difference in the pulsation, when felt

above and below the seat of the disease; if it be situated in the thorax, there may be dyspnœa and impeded action of the heart; if in the abdomen, it may be felt, or the functions of organs situated in that cavity injured; when in the pelvis, the urinary or generative functions may suffer. Spontaneous cures sometimes take place, either from *pressure* of a tumour, or of an aneurismal sac itself on the artery—from the *sloughing process being set up*—or from gradual cessation in the current and filling up of the tumour by coagula.

145. The means employed by the surgeon are—*pressure, spare diet, applications of cold, medicines calculated to diminish the current,* and *the ligature.*

The last is the one on which most dependence is placed, the others being only adapted for very small arteries,

There are few situations where the anastomosis is not sufficient to keep up vitality in the limb, provided warmth is applied till the branches have become enlarged; nevertheless, care must be taken that the ligature is not put too near a large branch, nor sufficiently near to the aneurism to incur the chance of tying the diseased coats.

146. *Aneurism* by *anastomosis,* or *nævus maternus,* is when a number of small vessels, carrying arterial blood, are collected together, and form a small vascular tumour, which continually throbs; *if it be not* extirpated, the pulsations become distinct, the tumour increases, bursts, and causes

death: this aneurism is *congenital,* and is at first of very small size. Sir Benjamin Brodie says, that the application of a very fine point of nitrate of silver to the supplying vessels, first touching the part with a lancet, will effect a cure when small. Vaccination, pressure, a seton passed through it, astringent injections, and even extirpation by the knife or ligature have been used for its treatment.

147. *Aneurismal varix* is a *dilated vein* communicating with an artery, and from it deriving a pulsation. It occurs sometimes in bleeding, where the vein has been transfixed and the artery beneath wounded, and where the external wound has healed, leaving the communication between the vessels open.

148. Varicose aneurism exists where there is a communication between the vein and artery, with an aneurismal sac *between* them.

ON VEINS.

149. Their *structure* is similar to that of arteries, but the coats are *less dense* and *elastic;* the fibres in the middle one are, in general, arranged *longitudinally,* but some few run in a circular direction.

Valves, or folds of the lining membrane (which is of a serous tissue), are found in many veins. They are in general disposed in pairs, and have their free edges looking towards the heart, by which arrangement the blood can readily pass in that direction, but regurgitation is prevented.

They are found in the veins of the extremities, especially of the lower one, and are most numerous in those which are superficial. They do not exist in those of the skull, spine, bones, lungs, portal or uterine veins.

The two external coats are deficient in the veins of the skull, which are called *sinuses;* nor are they to be found in those entering into bones. To compensate for their loss in the skull, a strong fold of dura mater surrounds the lining membrane, protecting it and preventing dilatation.

150. When emptied of blood, the walls of veins collapse, whilst those of arteries remain patulous; but they are less liable to rupture than arteries, in consequence of their yielding more: they also offer considerable resistance to distension in a longitudinal direction, and appear to possess irritability. They generally accompany arteries, but are less flexuous. The arteries of a large size have only one vein, but smaller ones are accompanied by two or more, called *venæ comites.* In childhood they are smaller in size than arteries, but in old age they acquire a larger calibre. In parts placed above the heart, they generally pass in front of arteries; whilst in those below this viscus they pass behind. There are, however, some few exceptions to this.

151. *Phlebitis* is more frequent than arteritis, and is much more dangerous; its symptoms are, redness and swelling along the course of a vein, extending in a direction towards the heart; rapid suppuration and collections of pus in them; great

constitutional disturbance; and fever, which quickly assumes a typhoid form, and if not arrested previous to the formation of pus, generally proves fatal.

Prompt and energetic treatment of the antiphlogistic kind can alone benefit. The local remedies are leeches, fomentations, and poultices.

152. *Dilatation* of a vein, or *varix,* is most frequent in the lower extremities, but the whole venous system is susceptible; it generally commences in one or two veins, which become tortuous and distended; this spreads, till at length many become affected. If the dilatation is not arrested, they at length either form ulcerations, or they burst;—by the dilatation which takes place the valves become useless.

153. Mechanical obstacles, or internal disease, offering an impediment to the flow of blood, may cause this complaint. The treatment consists either in the application of bandages and plasters, with rest, ligature or acupressure.

Ossification and other accidental formations are rare in the walls of veins; but occasionally obliteration follows inflammation.

ABSORBENTS.

154. Are those vessels which carry *chyle* and *lymph,* the former being called *lacteals,* the latter *lymphatics.* The *lymphatics* are found in all parts, and are arranged in a superficial and deep

set. The first are placed in the subcutaneous cellular tissue; the latter accompany the vessels, but they have frequent communication with each other. They are smaller than blood-vessels, appear to have two coats and many valves, and are cylindrical in form. In their course they pass through *ganglia* or *glands* which appear to collect the fluids from the various tubes, and amalgamate them. No lymphatics arrive at the trunk without passing through one or more of these.

It has been supposed that they commence on the skin, in the substance of organs, and on membranes; and it is known that they eventually empty themselves into the subclavian and internal jugular veins.

155. The *absorbent ganglia* are very numerous, and are found in most parts of the body, either near joints or accompanying blood-vessels; those of the *lacteals* are situated in the mesentery.

The structure of these glands is homogeneous; they have no secretory apparatus, and are called *conglobate*.

The *secretory* glands are quite different in structure, having a secreting apparatus, and an excretory duct; they are called *conglomerate*, as they consist of many secreting surfaces combined into one gland.

156. The thoracic duct is formed at the back part of the abdomen, opposite the third lumbar vertebra, by the union of several trunks which is called *receptaculum chyli*, and into which the lactea empty themselves. This duct passes through

aortic opening of the diaphragm into the thorax, having the aorta in front, and to the left—the vena azygos to the right; in the thorax it is placed in the posterior mediastinum; and at the fourth dorsal vertebra it inclines over to the left side, passes along the longus colli, ascends into the neck, curves downwards, and empties itself into the left subclavian vein, near its junction with the internal jugular.

The fluid in this duct is derived from the lacteals in the mesentery; from the lymphatics of the lower extremities, of the walls of the abdomen, and pelvis; from the left lung; left side of the heart; walls of left side of thorax; left upper extremity and corresponding side of head and neck. The lymphatics from the remaining portions of the body, including the right lobe of liver, empty themselves into the junction of the right subclavian and internal jugular veins, and their terminating duct is sometimes called right thoracic.

157. The absorbent vessels become very vascular when inflamed, and a familiar instance of this is a wound from dissection: the inflammatory action quickly spreads, attacks the glands, which participate and soon suppurate; the accompanying fever also rapidly assumes a typhoid type.

158. The glands are very liable to suffer from slow inflammation of a specific nature, which is *known by swelling*, pain, imperfect suppuration, *and very slow* progress. This well-known com*plaint is called scrofula*, and is not communicable,

but is hereditary. If it extends to the glands or structure of the lungs, it constitutes *phthisis;* if to the glands in the mesentery, *tabes mesenterica.*

Iodine, mineral water, sea-air, tonics, and generous diet are most likely to effect a cure.

CHAPTER VII.

ON THE ANATOMY AND SURGERY OF THE HEAD AND FACE.

159. IMMEDIATELY beneath the integuments is the *occipito frontalis muscle,* arising from the superior transverse ridge of the occipital bone by two fleshy bellies, and inserted into the pyramidalis nasi, orbicularis palpebrarum, corrugator supercilii, and integuments; it is firmly *adherent* to the skin, but is *loosely connected* to the pericranium, over which it slides.

Sloughing of its aponeurosis and collections of matter beneath, sometimes occur; they may be caused by wounds, but very rarely by erysipelas; the temporal, frontal, and occipital arteries are external to it.

160. In the *orbit* are seven muscles—levator *palpebræ, the* four recti, and superior and inferior *oblique; the* globe of the eye, and its appendages—*viz., lachrymal* gland, ducts, and sac; lenticular *ganglion,* and branches of sympathetic nerve

second, third, fourth, first division of fifth and sixth nerves, with their branches; ciliary nerves; reflections of conjunctiva with the peculiar fold on the inner side, called membrana nictitans, highly developed in birds; and at the posterior part of globe a large quantity of fat, the absorption of which in disease causes sinking of the eye into its cavity:—around the orbit are the two tarsal cartilages, of which the upper is the largest, and the only one which moves; eye-lashes; Meibomian glands; puncta lachrymalia; canaliculi; eyebrows; caruncula lachrymalis, and nasal canal (41).

161. On the face and forehead are sixteen pair of muscles—viz., orbicularis palpebrarum, pyramidalis nasi, corrugator supercilii, compressor nasi, levator labii superioris proprius, levator anguli oris, zygomaticus major and minor, orbicularis oris, depressor labii superioris, depressor anguli oris, depressor labii inferioris, levator labii inferioris, levator menti, and buccinator.

In the temporo-maxillary region are the masseter, internal and external pterygoid, and temporal muscles.

162. There are three salivary glands on each side; the *parotid* (*παρὰ* near, *οὖς* the ear), situated between the angle of the jaw and meatus-auditorius externus, the duct of which (Steno's) passes *across the* masseter muscle in a line drawn from *the lower* margin of ear to midway between nose *and mouth,* and piercing the buccinator, enters the

mouth opposite the second molar tooth. The *submaxillary*, situated between the base of the jaw on the mylo-hyoid, empties itself by its duct (Wharton's) near the frænum linguæ. The *sublingual*, much smaller than the others, lies close to the frænum, and opens by several minute orifices on each side of the tongue. The ducts of these glands are lined by the mucous membrane of the mouth, which is continued into their substance and forms secreting surfaces.

Salivary fistula is caused by a wound of the duct of the parotid, and is known by the escape of saliva on the cheek. In a recent case, pressure will sometimes suffice to cure it, but in general it is necessary to make a false passage by a seton or caustic. Plastic operations are frequently of use.

Ranula is an encysted myxomatous tumour beneath the tongue. It may be freely incised, or a portion dissected out; or a seton may be passed through it, and in some cases dissected out.

The *saliva* is composed of a peculiar animal principle; various salts of potash, of which the chloride of potassium and the sulphocyanide are the most numerous; of mucus, salts of soda, and some oxide of iron; it contains about 1 per cent. of solid matter only; it is slightly alkaline, and in this differs from the gastric juice, which is slightly acid.

163. The nerves which supply the forehead and *face* with *sensation* are—First division of fifth, or *ophthalmic*, of which the supra-orbital branch

emerges at a foramen of the same name. Second division, or infra-orbital, which emerges at the infra-orbital canal, between the levator labii proprius and levator anguli oris. Third division, or inferior maxillary, coming out from mental foramen. These nerves are accompanied by arteries derived from internal carotid and internal maxillary.

Motion is supplied to the same parts by the portio dura, which, after emerging from stylo-mastoid foramen, and passing through parotid gland, forms the pes anserinus, and is distributed to the temples, face, and upper part of neck.

164. At the lower part and back of skull are ten pair of muscles—viz., occipito-frontalis, attached to superior ridge; trapezius, to inner third of same; sterno-cleido-mastoideus, to outer third; complexus, to inner half of space between ridges; splenius-capitis, to outer half of same; rectus capitis posticus major, to inferior ridge; minor, to space beneath; obliquus capitis superior, to space between ridges,—all of which muscles are attached to occipital bone; trachelo mastoid, attached to mastoid process; rectus capitis lateralis, external to condyle.

In front of foramen magnum are rectus capitis anticus, major and minor; two superior constrictors of pharynx, and the muscles which move the palate.

165. The bones of the head, from their convex *shape and firm* structure, offer such protection to

the brain that extreme violence alone can injure it.

Fractures of these bones are divided into those *without* and those *with* depression.

166. Those *without depression* are as depressed fractures, dangerous, but if there has been much violence they may be accompanied by extravasations, and may require the application of the trephine; or by concussion, which must be treated accordingly.

167. When there is *depression*, the symptoms are, insensibility, dilated pupil, stertorous breathing, slow and oppressed pulse, relaxation of the limbs from paralysis of the voluntary muscles, involuntary evacuation of fæces from paralysed state of the sphincter ani, retention of urine from same state of muscular fibres of bladder.

The inner brittle table of the skull may be driven in without any *external signs of depression*, or the external plate may be crushed *without injury* to the vitreous. In children they sometimes regain their shape after depression has happened.

A sensation similar to fracture is communicated sometimes by *blood beneath the scalp*, but it may be detected by passing the finger along the surface, when this will be raised at the circumference of the tumour, before it sinks in the centre.

168. *Extravasation of blood* may be mistaken *also for fracture;* but it comes on gradually, and frequently follows concussion, while the symptoms in fracture are immediate.

Rupture either of the anterior, middle, or pos terior meningeal arteries or sinuses is frequently the *cause* of extravasation, and the blood is then found *between the dura mater and skull;* this is the only kind of extravasation likely to be relieved by the trephine. It is sometimes very difficult to detect; escapes of blood are most frequent at the base of the brain, and when copious, almost always prove fatal.

169. Suppuration may also follow compression; but it does not occur until inflammation has set in, and some days have elapsed. The symptoms are similar, but the former is preceded by rigors.

170. Fractures at the base of the skull are only caused by great violence, and usually are produced by falling from a height on the head, when the weight of the body causes the fracture by *contre-coup.* Besides the other symptoms, there is *bleeding* from the *ears, nose,* and *mouth,* and escape of cerebro-spinal fluid.

171. *Treatment of compression,* whether the symptoms are from depressed bone or extravasation, is to shave the affected part of the head; to expose the skull by making a straight or crucial incision, and to apply the *trephine* on the sound bone, but as near the depressed portion as possible; the pin should be removed after a groove has been formed, and care taken lest any irregularity of the inner table of the bone may cause the instrument to wound the dura mater; the depressed portion is then to be raised and the wound closed. It must be remembered that there is

diploë in children, and that when the dura mater is wounded, bleeding follows. The *trephine* is not to be applied, however great the depression may be, unless there are symptoms of *compression* or *inflammation;* and great care must be taken when applied over the course of a sinus.

172. *Concussion* may occur with various degrees of severity; it is sometimes unattended with any loss of function, or organic change; but in more severe cases, laceration of the brain and slight extravasation have been found.

The first *symptoms* are, loss both of sensation and motion, rigid state of limbs, small intermitting pulse, sometimes even not to be felt, pupil immovable and generally contracted, cold extremities, breathing difficult but unattended with stertor; when the symptoms are not so severe, or where slight reaction has taken place, there is vomiting, tinnitus aurium, vertigo, some degree of sensation at intervals, and the patient lies as if asleep, and if roused and questioned, he answers hastily and again relapses into apparent insensibility.

In a severe case the patient may die instantly, but in a less complete one, there is great danger in *reaction,* as inflammation of the brain is likely to follow—the case may then terminate in idiotcy, or there may be loss of some of the faculties, as *the memory* or hearing.

173. *The diagnosis* between concussion and *compression* is as follows:—In the former, the *limbs are rigid;* in the latter, relaxed; in the

former the pulse is either regular or intermittent; in the latter, slow and laboured; in the former, the breathing is either tranquil or hurried; in the latter, stertorous; in the former, there is generally some degree of sensation left, as the patient either answers when spoken to several times, or draws away his limbs when pinched; in the latter there is complete insensibility; in the former, the pupil is contracted; in the latter, dilated; in the former, the bowels are not relaxed, whilst in the latter there is involuntary evacuation of fæces; the former always commences suddenly, whilst the latter, if from extravasation, need not; in the former, the surface of the body is cold, and the depression corresponds to the severity of the attack, whilst in the latter such is not the case. These diagnostic symptoms, although laid down by many authors, are not always to be relied on, and it must be borne in mind that the two states may be coexisting, or compression follow on concussion.

174. *Treatment.*—In the severe kinds, where all sensibility is gone, the less that is done the better, beyond applying external stimulants and warmth. After reaction has set in, bleeding, purging, low diet, counter-irritation, and quiet, must be resorted to, to prevent inflammation, and the case must be closely watched for some time.

Wounds of the scalp are not so dangerous *of themselves*, but may give rise to erysipelas, *formations* of matter, exfoliations of bone, and *inflammation* of the brain or its membranes.

175. *Inflammation of the brain*, when resulting from external violence, comes on from the seventh to the tenth day, but requires the same treatment as from other causes.

176. *Hernia cerebri* is either a real protrusion from a wound of brain through an aperture in the skull, or it may be caused by blood forcing the brain and its membranes into a tumour which protrudes, or by a diseased growth from brain on dura mater. It is accompanied by pulsation, and frequently continues to increase in size. Pressure and excision are the plans of cure adopted.

177. Wounds of the dura mater are dangerous, as inflammation spreads rapidly to the lining membranes of brain, and brain itself; therefore great caution must be adopted in removing foreign bodies.

CHAPTER VIII.

ANATOMY AND SURGERY OF THE NECK.

178. THE *superficial fascia* is simply a continuation of that which is found at most parts of the body, and lies immediately beneath the skin.

179. The platysma-myoides muscle is next seen, *arising* by indistinct fasciculi over the pectoralis major and anterior part of deltoid; it passes upwards towards the face, at the chin meets with a similar muscle from the opposite side, and is in-

serted in the lower jaw and muscles of face; it is necessary to remember the course of its fibres, since situated underneath it, is the

180. External jugular vein, the direction of which corresponds with the fibres of the above muscle; it is formed by the internal maxillary and posterior auricular vein; sends a branch of communication to the internal, descends over the sterno-cleido-mastoideus, and empties itself into the subclavian vein, external to the outer border of the sterno-mastoid; it also in its course receives several veins from the posterior and anterior parts of the neck.

Bleeding from the jugular is performed in this vein, and the part selected is that where it crosses the sterno-mastoid, as it is most prominent there; by pressing on the vein a little above the clavicle, and making an oblique incision above the pressure, there is little difficulty in obtaining blood; but if the incision were made in the direction of its course, the fibres of the platysma would only be separated, and would close the aperture on withdrawing the lancet. The bleeding ceases when pressure is removed, but a compress over the wound may be applied if necessary.

181. Between the above vein and the sterno-mastoid lies the *deep* cervical fascia, which is strong and important; it is continuous anteriorly, *with a similar* fascia on the opposite side; posteriorly *it is lost* in the cellular tissue in front of the *trapezius;* at the upper part it binds down th

parotid gland, and is attached to the zygoma, styloid process, and ear; at the lower part of the neck it also binds down the subclavian vessels, and is cut through in tying the subclavian artery; at this part it is divided into two layers, one of which passes in front of the clavicle, and is lost on the pectoralis muscle; the other, passing behind the clavicle, encloses the subclavius muscle, and by its attachment to the coracoid process and first rib, forms the *costo-coracoid* ligament, which is of sufficient strength to prevent pressure on the artery *below* the clavicle restraining hæmorrhage; at the anterior and lower part of the neck it is stretched tightly across from one sterno-mastoid to the other, and below is attached to the sternum. In Allan Burn's Surgical Anatomy, cases are mentioned where destruction of the fascia at this part has impeded breathing, by removing the protection from external pressure during inspiration.

Posteriorly, the deep fascia lies internal to the trapezius; anteriorly, it sends various lamellæ between the muscles, the most important of which is one passing internal to the sterno-mastoid, and forming the sheath for the carotid artery.

182. Each lateral half of the neck is divided into two triangular spaces by the sterno-mastoideus, and these are again divided by the omohyoid muscle into similar shaped spaces. *In the posterior superior* lies the cervical plexus of nerves, *with its branches*, the spinal accessory nerve, and *deep muscles*. *In the anterior superior* are the

external and internal carotid, a portion of common carotid, parotid and submaxillary glands, stylo-hyoid, digastric, mylo-hyoid, stylo-glossus, and stylo-pharyngeus muscles, the larynx and its muscles, the internal and external jugular veins, the pneumogastric, sympathetic, lingual and descendens noni, pharyngeal plexus, descending laryngeal, glosso-pharyngeal, and spinal accessory nerves.

In the *anterior inferior* are the trachea, common carotid, internal jugular, pneumogastric, sympathetic, recurrent laryngeal, and descendens noni nerves: branches of subclavian artery, thyroid gland, and depressor muscles of larynx.

The *posterior inferior* contains the subclavian artery and vein, with branches of the axillary plexus of nerves.

The phrenic nerve lies behind the sterno-cleido-mastoid muscle, and in front of scalenus anticus.

COMMON CAROTID.

183. A line drawn from the sterno-clavicular articulation to the angle of the jaw gives the direction of this *artery*, but in the operation for tying it the inner border of the sterno-mastoid is sufficient guide; on the right side it extends from the above-mentioned articulation to the upper *border of thyroid* cartilage, or to a level with the *third vertebra;* on the left, from the arch of the *aorta to the same* point; from its commencement

on the right side to midway up its course, where it is crossed by the omo-hyoid muscle, it is covered by the sterno-mastoid, hyoid, thyroid, and platysma-myoides muscles, descendens noni nerve, and fascia; in its upper half it has fascia alone superficial to it; within the same sheath is the internal jugular vein to its outside, and the pneumogastric nerve between and behind; in a separate compartment to its *outer* side lies the sterno-mastoid muscle, to its *inner* the trachea and recurrent laryngeal nerve; *behind it*, posterior to the sheath, is the sympathetic nerve, inferior thyroid artery, recurrent laryngeal nerves, and rectus capitis anticus major and longus colli muscles.

The left artery, whilst in the thorax, has *in front* the left vena innominata, sternum, and muscles arising from it; *behind*, the trachea and thoracic duct; *internally*, the œsophagus; *externally*, the subclavian artery and pneumogastric nerve: having passed out of the thorax, it has the same relative situation as the other artery.

184. This artery divides into the internal and external; as it gives off no branches, it has been tied at its upper part, for aneurism at the commencement or at the arteria innominata, an operation named from its inventor, Mr. Wardrop.

185. *Wounds* of the throat rarely injure either *this vessel* or the external carotid, as they lie deeply between the most prominent parts of the sterno-mastoid and the thyroid cartilage; but

hæmorrhage from the branches of the latter soon causes death, unless a ligature is applied; in case of a wound, the arteries are to be tied, the head and shoulders raised, and secured in a bent position with a bandage; plasters are not to be applied, lest internal hæmorrhage and suffocation, from loss of passage for air, take place, but two or three sutures must be used instead. The student should bear in mind, that if the pneumogastric nerve be cut through or included in the ligature, the chances of recovery are very slight; that where the œsophagus is wounded, which is rare, from its deep situation, the patient must be fed through a tube introduced at the nose; and that this may often be done advantageously, when only the trachea has suffered; that frequently inflammation follows these wounds when bleeding becomes necessary; and that although a patient may proceed favourably for some time, he is liable to die from secondary hæmorrhage producing suffocation, or from exhaustion and the ulcerative process.

186. The anastomosing branches, which carry on the circulation to the head when a ligature has been applied to the carotid, are the inferior thyroid with the superior, the vertebral with the internal carotid, the cervicalis ascendens with the muscular and occipital, and the cervicalis profunda with the arteries distributed to the deep muscles of the neck and the princeps cervicis from the occipital.

187. The relations of the external carotid, which extends from the bifurcation to the middle

of the parotid gland, are, *in front,* the stylo-hyoid, digastric and platysma-myoides muscles, and lingual nerve; *behind,* the stylo-hyoid and stylo-pharyngeus muscles with the glosso-pharyngeal nerve, all of which separate it from the internal carotid; at its *upper part* it lies in the parotid gland, where it is crossed in front by the portio dura nerve.

Its *branches* are ten in number—viz., three in front, the superior thyroid, lingual, and facial; at its posterior aspect, three, the muscular, occipital, and posterior auricular; passing upwards, four, the ascending pharyngeal, temporalis faciei, internal maxillary, and temporal.

The *superior thyroid* is most liable to suffer in a wound from a razor across the throat; it gives off four branches, and supplies the larynx and thyroid gland. The *lingual* is separated from the preceding by the os hyoides, and also gives off four branches, the hyoid, dorsalis linguæ, sub-lingual, and ranine; it lies on the middle constrictor and lingualis, and is separated, in its middle stage, from the nerve of the same name by the hyo-glossus muscle: in dividing the frænum linguæ there is danger of wounding the *ranine branch* if the incision be too near the tongue, and to avoid this the point of the scissors should be directed downwards.

The *facial* gives off ten branches, four before *it passes* over the base of the jaw, six afterwards; *they are,* the submaxillary, tonsillitic, submental, and *inferior* palatine; after passing on to the face the inferior labial, inferior and superior coronary, lateralis nasi, angular and masseteric branch: this artery describes a tortuous course, to allow of the motious of the jaw; its coronary arteries require compression in the operation for hare-lip, and its angular branch anastomoses with the internal carotid, whilst it terminates by anastomosing with the internal maxillary at the infra-orbital foramen.

The *occipital* artery passes beneath the sterno-mastoid, trachelo-mastoid, splenius, and complexus muscles, and superficial to the internal jugular vein, hooks round the lingual nerve, and taking the direction of the posterior belly of the digastric, grooves the occipital bone, and is distributed to the posterior part of skull after giving off many branches, of which the princeps cervicis and inferior meningeal may be mentioned. The *muscular* is distributed to the sterno-mastoid; the *posterior auricular* to the external ear and side of the head. Of the ascending branches the *superior pharyngeal* is given off at the bifurcation, and supplies the pharynx, tonsil, Eustachian tube, and dura mater. The *transversalis faciei* runs across the masseter in the direction of Steno's duct; the *internal maxillary* passes between the neck of the lower jaw and internal lateral ligament, then between the two pterygoid muscles to the pterygo-maxillary fossa; its branches are the same in number as the external carotid and the facial—viz., ten, the middle meningeal, inferior dental, pterygoid, deep temporal, buccal, masseteric, superior dental, infra-orbital, nasal, and descending palatine. The middle meningeal passes through the spinous foramen and grooves the sphenoid, temporal, sphenoid again, and parietal. The terminating branch of the carotid is the *temporal*, which divides into two branches, the anterior being the one selected for bleeding from, as it is most superficial A considerable branch perforates the temporal fascia and muscle, and anastomoses with the deep temporal arteries.

The external carotid terminates in the parotid gland, midway between the angle of jaw and zygoma; it there divides into its terminal branches, having the pes anserinus and external jugular vein superficial to it.

188. The *subclavian artery* forms an arch extending from the sterno-clavicular articulation on the right side to the lower border of the first rib; it is crossed about its middle by the scalenus-anticus muscle, and is thus divided into three portions—the *inner*, extending from its origin at the arteria innominata to the inner border of scalenus, has *in front* sterno-mastoid, hyoid, and thyroid muscles, fascia, internal jugular vein, and pneumogastric nerve; *behind*, recurrent laryngeal and sympathetic nerves, and longus-colli muscle; the middle portion lies behind the scalenus-anticus muscle and phrenic nerve, the latter crossing the artery close to the inner border of the muscle; *behind* this portion is the scalenus posticus, and *below* the pleura; the external third lies in a tri

angular space formed by omo-hyoid above, clavicle below, and scalenus-anticus internally, and is only covered by skin, fascia, and platysma-myoides; behind is the scalenus-posticus, and inferiorly the first rib: the *subclavian vein* lies below and in front in the *first portion;* in front, and separated by scalenus *in second;* and in front and below, *in third portion.* The brachial plexus of nerves lies above and behind the artery, after passing between the two scaleni muscles. On the left side the subclavian arises from the arch of aorta opposite second dorsal vertebra, and ascends perpendicularly to the sterno-clavicular articulation, from whence it takes the same direction as the right; whilst in the thorax it has *in front* the left lung and pleura, pneumogastric nerve, left carotid artery, thoracic duct, left jugular vein, and vena innominata, sterno-mastoid, hyoid and thyroid muscles, sternum first rib and clavicle; to its *inner* side is the œsophagus; to its *posterior,* the longus colli, and inferior cervical ganglion of sympathetic.

The branches are five in number—1st, internal mammary, which, passing down anterior mediastinum, anastomoses with epigastric artery; 2nd, vertebral, which enters vertebral foramen in fifth or sixth cervical vertebra, and after passing up through the different cervical vertebræ, winds behind the articulating process of atlas, enters the skull through foramen magnum, and joining the artery of opposite side, forms the basilar; 3rd, the thyroid axis, a short trunk given off at the inn edge of scalenus anticus, soon divides into four branches—viz., the inferior thyroid to the thyroid gland, the cervicalis ascendens to the muscles at the side and front of the vertebræ, the transversalis humeri to the supra-spinous fossa, the transversalis-colli to the base of the scapula; 4th, cervicalis profunda to the muscles between spinous and transverse processes of cervical vertebræ; 5th, superior intercostal to the two or three superior intercostal spaces.

189. A ligature can only be applied in the third portion of the subclavian without difficulty, and the operation is thus performed:—the integuments are to be drawn down, and an incision made over the clavicle from the outer margin of sterno-mastoid to the margin of trapezius: the platysma-myoides and fascia are then to be divided to a similar extent, and upon relaxing hold of the integuments the incision will be immediately over the artery; the external jugular vein is to be pressed to the inner side, and a ligature passed from below upwards; by observing this rule of passing the ligature from the side of the vein not only in this but in all operations on arteries, the danger of venous hæmorrhage is avoided.

There is a free supply of blood to the arm in a few hours by the anastomosis of the internal with the external mammary or thoracica longa, and the thoracica superior: by that of the cervicalis profunda with the arteries of the shoulder; by that of the transversalis humeri with the thoracica acromialis; by that of the transversalis colli with the subscapular; and by that of the thoracica longa with the epigastric.

THE PHARYNX.

190. Is a musculo-membranous bag, extending from basilar process of occipital bone to the fifth cervical vertebra; it is attached above by the superior and middle constrictors with the lining membrane to the bones, and below is continuous with the œsophagus: there are seven openings into it; they are, the two posterior nares, the isthmus faucium, the Eustachian tubes to the tympanum, and the entrances to the larynx and œsophagus. The *superior constrictor* is the most internal of the constrictors; it arises from the lower half of posterior border of internal pterygoid plate, from pterygo-maxillary ligament, from side of tongue and from lower jaw, close to last molar tooth, and is inserted into basilar process and raphé: *the middle* arises from the greater cornu of os hyoides, and is inserted into basilar process and raphé; the *inferior*, which is most superficial, arises from alæ of thyroid and cricoid cartilages, and from first and second ring of trachea, and is inserted into raphé; the lower fibres of this muscle are continuous with œsophagus.

Between the origin and insertion of the superior constrictor is a space called *sinus of Morgagni*, *opposite* which the *Eustachian* tubes pass; and on each side, and in front of the pharynx, is a space which is bounded anteriorly and posteriorly by palato-glossus and palato-pharyngeus muscles, and in which the tonsils lie; on the outer side of these bodies are situated the internal carotid artery and pharyngeal plexus of nerves; which must be cautiously avoided in opening the tonsil.

191. The *uvula*, from relaxation or enlargement, may require *removal; ligatures, caustic*, and *excision*, are the means of treatment recommended; modern surgeons, however, prefer the latter, and simply use *a pair of scissors* for performing the operation, or a probe-pointed curved bistoury, with a little lint wrapped round it, till an inch or so from the point.

192. When *foreign bodies* are lodged in the *pharynx*, attempts must be made to extract them by introducing the finger or forceps; if these do not succeed in dislodging them, dilatation may be attempted by a canula with a piece of sponge at the end; or if this fails, they must be pushed into the stomach by a probang, or by making the patient swallow some large substance, as a potato.

In cases of poisoning from vegetable poisons, the canula of the stomach-pump must be introduced into the stomach: a gag having been fixed between the teeth, the tube is to be passed to the back of the throat, and thence downwards: there is not much danger of entering the larynx, as the back of the tongue tends to protect it; suffocation or violent coughing would soon indicate such an accident. The stomach-pump is not admissible in cases of poisoning from corrosive preparations, but is undoubtedly the most efficacious where laudanum or other vegetable poisons are in the stomach, or where large quantities of alcohol have been swallowed.

THE LARYNX.

193. Consists of four cartilages—the *thyroid*, *cricoid*, and *two arytænoid;* and three fibro-cartilages—the *epiglottis* and *two cornicula laryngis*. The muscles attached to the *thyroid cartilage* are—sterno-thyroid, thyro-hyoid, crico-thyroid, inferior constrictor, thyro-arytænoid, and stylo-pharyngeus.

The inferior cornu of this cartilage is articulated to the cricoid by a distinct synovial membrane and ligament, forming a moveable joint.

The *cricoid* has attached to it the crico-thyroid, crico-arytænoideus lateralis and posticus, and inferior constrictor.

The *arytænoid* are situated upon the cricoid, and are connected to each other by muscles, to the cricoid by ligaments and muscles, and to the thyroid by two folds of membrane on each side, which extend from the summit and from the base of arytænoid to middle of angle in thyroid; these are called ligaments; and the inferior, which are the most prominent, and have some muscular and *ligamentous* fibres enclosed by the membrane, are called *chordæ vocales;* they have a triangular opening—the rima glottidis, which forms the entrance into the larynx, and immediately above which is placed the ventricle; *the membranes* of the larynx are *thyro-hyoid* and *crico-thyroid,* uniting the cartilages and os hyoides together, whilst below the cricoid is connected to trachea by a similar membrane.

194. The muscles which *raise* the larynx are—mylo, stylo, and genio-hyoid, the digastric, the stylo-pharyngeus, genio-hyo-glossus, and middle constrictor; and as the mouth is closed whilst deglutition is performed, most of them then acquire a fixed point to act from, and not only raise but draw forward the larynx, thus increasing the opening into the *pharynx;* this action also, by bringing the larynx against the epiglottis, which is prevented ascending by the tongue, *closes* the entrance, and prevents food passing into the larynx. As soon as food has passed the entrance of larynx, the mouth opens, and the epiglottis no longer closes the larynx.

195. *Laryngotomy* is performed by making a slit in the *crico-thyroid membrane,* and is required where food or other bodies have become impacted in the rima glottidis; it should not be performed until a probang has been passed into the œsophagus, to ascertain distinctly that the body is not placed there, and only pressing on the larynx: when the incision has been made, a probe may be introduced through the wound, for the purpose of

pushing up the substance into the mouth; a sudden sensation of suffocation, with difficulty of breathing and lividity of features, indicates the presence of such substance.

196. *Tracheotomy* consists in making an opening into the trachea, and is to be preferred where there is obstruction to the breathing by a foreign body in that tube: an *incision* of an inch or more in length is to be made in a perpendicular direction, and an aperture made through three or four rings of trachea; coughing will then frequently expel the substance; but if not, by placing the patient on his head, the foreign body will pass either out at the opening made, or through the rima glottidis. The isthmus of the thyroid gland lies across the third and fourth rings, and is to be avoided by pushing it upwards; the aperture should not be closed until bleeding has entirely ceased; if the operation be performed to relieve respiration, a portion of a ring may be removed and a tube introduced.

197. The *larynx* is supplied—with blood, by branches from the *lingual, superior thyroid*, and *pharyngeal* arteries; with nerves, by the pneumogastric and sympathetic.

At *puberty* the *pomum Adami*, or angle of thyroid cartilage, becomes much developed, and by its projection increases the size of the chordæ vocales and the rima glottidis. This happens only in the male, the larynx in the female continuing through life to retain its rounded form.

CHAPTER IX.

ON THE ANATOMY AND SURGERY OF THE THORAX.

198. THE ribs and sternum afford not only protection to the organs of respiration and circulation contained in this cavity, but by means of their articulation with the vertebræ, and by the oblique direction forwards of the sternum, which admits of movement upwards and forwards, they give room for the expansion necessary in these organs.

The peculiar twisted appearance of the shaft of a rib is also of much importance when the chest is dilated, as by that arrangement only could its flat surface be always applied to that cavity (36).

199. Lining these walls is the pleura costalis, a serous membrane, which is reflected on to the lungs opposite the fourth dorsal vertebra; it encloses the bronchial tubes, pulmonary arteries and veins, the bronchial branches from the pneumogastric and the sympathetic nerves, together with the absorbents and glands. After thus surrounding the root of the lungs, it is continued over the whole surface of these organs, passing in between the lobes.

200. The lungs are of a conical shape, of a yellowish-grey colour, of less density than other organs, and composed of ramifications of the bronchial tubes, of the pulmonary and bronchial arteries

and veins, of the nerves, absorbents, bronchial glands, and cellular tissue.

The minute terminations of the bronchial tubes are called air-cells, and are surrounded by the capillaries of the arteries, by the veins, absorbents, &c.; thus, the mucous membrane is interposed between the air-cells and the blood.

These organs correspond in general shape to the interior of the thorax; but as they are in approximation only in the median line, they leave two intervals called *mediastina*, in front and behind; in the right lung are three fissures, which divide it into three lobes, in the left only two; an interval is also left between the two lungs inferiorly and the diaphragm, which interval being rather to the left side, causes that lung to be narrower than the other, whilst the right is broader, but shorter, in consequence of the liver pressing upwards the diaphragm.

201. The *trachea* (τραχεια ἀρτηρὶα, aspera arteria), a cylindrical tube, composed of horseshoe shaped, united behind by a fibrous band containing muscular fibres (*trachealis muscle*), cartilaginous rings, and lined by mucous membrane, extends from the cricoid cartilage to the third dorsal vertebra, where it divides into the two bronchial tubes, of which the right is the shortest, but the largest in diameter.

202. *The anterior mediastinum* is smaller than *the posterior*, and gives lodgment only to the *remains of the* thymus gland, the internal mammar

artery, and vein of the left side, the origins of the sterno-hyoid and thyroid muscles, the triangularis sterni muscle and cellular tissue and lymphatics; the *middle mediastinum* contains the heart in pericardio, phrenic nerves, and comes nervi phrenici-arteries; the *posterior mediastinum* contains the œsophagus, pneumogastric and splanchnic nerves, the descending aorta, intercostal arteries, thoracic duct, vena azygos, and lymphatic glands. The parts passing through the upper aperture of the thorax, which is the space enclosed by the sternum, first ribs, and first dorsal vertebra, are—the sterno-hyoid, thyroid, and longus-colli muscles; the trachea, œsophagus, pneumogastric, sympathetic, left recurrent laryngeal and phrenic nerves; thoracic duct, the innominata, internal mammary, superior intercostal, left carotid and subclavian arteries; right vena innominata, left subclavian, and left internal jugular veins.

203. The *diaphragm* (*Διάφραγμα*, septum), which forms the lower boundary of this cavity, is convex on its upper surface, and lower at its posterior than its anterior part; it arises by fleshy fibres from the internal surfaces of the six or seven lower ribs, from the ligamenta arcuata, and by two pillars from the sides of the bodies of the four upper lumbar vertebræ on the right, from three only on the left; these fibres converge, and are inserted into a central aponeurosis which resembles a trefoil leaf; there are three apertures through this muscle, one of which, quadrilateral, and situated in the

central aponeurosis to the right side, gives passage to the vena cava inferior and branches of the right phrenic nerve; another to the left, which is formed by the muscular fibres of the pillars crossing each other, gives passage to the œsophagus and pneumogastric nerves; below, and to the right side of this last opening, is a space between the crura, through which pass the aorta, thoracic duct, and vena azygos. The splanchnic nerves generally pass through the crura.

204. The relative position of the vessels at the root of lung (190) is thus:—on both sides the veins are below and in front, the arteries behind, and the bronchus most posterior; on the right, the bronchus is superior; on the left, these vessels are nearly behind each other, but the artery slightly higher.

205. The *muscles of inspiration* are the ordinary and extraordinary ones; the first are the diaphragm, intercostals, and levatores costarum; the second, which only act when the arms become a fixed point by taking hold of some body, are—the trapezius serratus magnus, pectoralis major and minor, serratus posticus superior, scaleni, latissimus dorsi, and subclavius muscles.

During inspiration, the diaphragm, by its contraction, becomes less convex, whilst at the same time the diameter of the thorax is increased from *before backwards* by the action of the intercostals. *In asthma,* and diseases affecting respiration, the *extraordinary* muscles are called into action. As soon as the lungs are inflated with air the muscles of expiration are brought into use, and by drawing down the ribs and pressing the viscera against the diaphragm, which is then restored to its former inactive state, they diminish the thoracic cavity; they are the obliquus externus descendens abdominis, obliquus internus ascendens, transversalis, rectus, pyramidalis, serratus posticus inferior, quadratus lumborum, latissimus dorsi.

206. The blood of the pulmonary arteries, which is venous, and thickly charged with carbonaceous matter, passing to the air cells, meets with oxygen from the air, which, penetrating to it by endosmose or capillary absorption, unites with the carbon, forming carbonic acid, which is expelled during expiration. The venous blood is thus arterialized by the separation of the carbon and absorption of oxygen, being changed from a dark to a bright red colour.

This formation of carbonic acid in the lungs, by the junction of the carbon of the venous blood and oxygen of the air, is similar to the process of combustion, and gives rise to the development of caloric, forming "*animal heat,*" which, becoming absorbed by the arterial blood, exists in it in a latent state, and is subsequently given off in the capillary circulation.

Some physiologists have supposed that animal heat is generated during the process of digestion; others, that it is formed in the capillaries; others, that nervous energy will account for it, particularly at the gangliac distribution on the coats of the blood-vessels.

207. The *heart* (κῆρ, cor) is a hollow muscle, of a conical shape, contained in the fibro-serous pericardium, and lying obliquely from right to left on the diaphragm; its *apex* pulsates at the space between the *fifth* and *sixth rib*, about two inches from the sternum on the left side, whilst its base, directed upwards, backwards, and to the right side, and separated from the vertebral column by the aorta and œsophagus, is situated about the level of the *fourth rib* on the right side; it consists of three coats, the external of which is formed by the serous reflection of the pericardium; the middle, by the muscular fibres arranged in three directions; and the internal, by a lining membrane, or *endocardium*, continuous with that lining the vessels.

The external muscular fibres pass longitudinally from base to apex; the internal pass round each of the cavities, whilst the intermediate pass from one side to the other along the septum, resembling a figure 8 in shape. There are *four cavities*—viz., the right and left auricles and ventricles; but the latter alone are really situated within the muscular structure, the two auricles being connected to the ventricles only by the outer and inner membrane, and an intermediate fibrous structure. The right *side of the* heart is flabby and thin, whilst the *cavities on* the left side have much thicker *muscular* covering, and are of much firmer structure; on the external surface the division between the auricles and ventricles is marked by a transverse *sulcus*, and the situation of the septum by a vertical line of adipose tissue, in which the principal branches of the coronary vessels run.

The *right auricle* is somewhat quadrilateral in shape: its muscular fibres run in various directions, but in the *appendix* auricularis, which is situated between the ventricle and root of aorta, the fibres run parallel, and are named *musculi pectinati;* the *openings* into the *auricle* are—ascending and descending cavæ, foramina Thebesii, auriculo-ventricular opening and coronary vein; between the entrances of the cavæ is seen the tuberculum Loweri, and in the septum is the annulus ovalis, marking the site of the foramen ovale in the fœtus. Extending from the entrance of the inferior cava towards the septum, a semilunar fold of membrane called the Eustachian valve is seen, immediately beneath which is the entrance of the coronary vein. The *tricuspid* valve between this cavity and the ventricle is formed, as the other valves of the heart are, by a reduplication of the lining membrane; it has three folds, of which the one nearest to the septum is the largest, and closes the entrance to the pulmonary artery; from the floating extremities of these folds tendinous strings, *chordæ tendineæ*, are continued into the ventricle, *and are firmly* attached to fleshy bodies, called *carneæ columnæ*, some of which extend across this *cavity, whilst* others are free.

The *semilunar valves* are situated both at the entrance of the pulmonary artery and the aorta; they have three folds, and in the centre of their free margin a small body called *corpus aurantii;* from this valve proceeds upward the *pulmonary artery*, which, after passing out of the pericardium, separates into a branch for each lung. In the fœtus, a third branch exists which joins the aorta, *ductus arteriosus.*

The *left auricle,* smaller than the right, contains a similar appendix, and is similar in structure; it is separated from it, posteriorly and in the middle, by the septum alone; but anteriorly the pulmonary artery and aorta are interposed. *Four pulmonary veins* open into it, and it communicates with the ventricle by an *auriculo-ventricular opening,* at which is seen the *mitral valve;* the inner and larger fold of which closes the entrance to the aorta.

The left ventricle is smaller, but has its walls more dense than the right, and is situated nearer the apex; *carneæ columnæ* and *chordæ tendineæ* are also seen here.

208. The *aorta* commences at the inner side of this cavity, and directly behind each semilunar valve forms an enlargement (*sinus of Morgagni*) in which commence the two coronary arteries; it then extends upwards, forwards, and to the right *side, and on* reaching the level of the junction of *the second rib,* on the right side with the sternum *passes* horizontally backwards and to the left, t

it arrives opposite the second dorsal vertebra; thence it descends and continues to pass down the front and side of the vertebræ till it reaches the diaphragm; from the heart to the level of the point where it is given off—viz., to the fourth rib—it is called the *arch*, but afterwards the *thoracic aorta.* The *ascending* portion of this vessel lies within the fibrous envelope of the pericardium, which mingle with its coats at the curvature; at the commencement the pulmonary artery lies in front; *to its posterior* aspect is the auricle, and higher up the right root of the lung; to its *right side* the superior vena cava, and to its *left* the pulmonary artery. *The transverse portion has, in front,* the sternum, left pneumogastric, left phrenic, and—crossing above and in front—the left vena innominata; *behind* it the bifurcation of trachea œsophagus, left recurrent laryngeal nerve, and thoracic duct.

The descending portion is close to the left side of the dorsal vertebræ, and has in front the left root of the lung.

Passing *through* the arch are the right pulmonary artery, left bronchus, and left recurrent laryngeal nerve.

209. The serous portion of the pericardium is conducted to the base of the heart by the large *blood-vessels,* but the fibrous portion is continued *up the aorta and* other vessels for a considerable *distance, forming* sheaths for them. The only *vessel which has* no sheath is the ascending cava

as this vessel passes through the diaphragm internal to the attachment of the pericardium with the aponeurosis.

210. *The coronary arteries* are two in number, and are destined for supplying the structure of the heart with blood; the right or larger emerges close to the right border of the pulmonary artery, in the groove between the auricle and ventricle; it divides into two branches, one running along the sulcus, the other running on the posterior surface of the septum towards the apex; the left emerges on the left side of the pulmonary artery, and also divides into two branches, one passing along the sulcus, the other on the anterior surface down to the apex. There is only one *coronary vein* which empties itself into the right auricle, near the junction of the ascending cava with the auricle.

211. *Aneurisms* are frequent along the aorta, and may be situated either *within* the pericardium or *without*; in the former case, rupture would cause instant death by the rapid escape of blood into the cavity, stopping the heart's action; in the latter, it might not, as the pressure against the sternum or spinal column might prevent it, and might even cause absorption of these bones. The symptoms of aneurism of the aorta are obscure, but there is *syncope, bruit de soufflet* heard, and *difficulty* of breathing.

212. The *phrenic nerve* arises from the fourth *ervical* nerve principally, but receives a smalle

branch from the third, and also one or two from the brachial plexus; it descends between the rectus capitis anticus major and scalenus anticus, then runs down upon the scalenus, crosses the subclavian artery (188) between it and the vein, enters the anterior mediastinum in front of the internal mammary artery, after communicating with the inferior cervical ganglion of the sympathetic, and passes between the pleura and pericardium to the diaphragm, to which it is principally distributed; the left winds round the apex of the pericardium, and is consequently the longest—it sends some filaments through the diaphragm to the solar and cœliac plexus, to the œsophagus, and to the crura of the diaphragm; the right, which is more anterior, sends filaments to the hepatic and gastric plexuses; in its course, this nerve gives supra-clavicular twigs, which go to the integuments of the shoulder and arm, filaments to the deltoid, pectorales, and other muscles; ascending filaments towards the jaw, some of which inosculate with the facial; in the thorax it does not give off many twigs till it divides into several for its final distribution.

In *hepatic disease* pain is felt in the right arm and shoulder, and this may be accounted for by remembering that some of the twigs of the phrenic pass to the shoulder, and that others pass to the liver with the hepatic plexus.

In *thoracic disease* there is also pain in the shoulder, but it is then caused by the intercostal or *nerves of Wrisberg*, which are distributed to the integuments of the arm.

213. In the lower order of animals, where there is only a single heart, or one with only two cavities, the *circulation* is single; but in man, where the heart possesses four cavities, the *circulation* is double—namely, the *pulmonary* and *general.*

The blood, from all parts of the body, is conveyed by the two cavæ to the right cavities of the heart, and thence to the lungs, where it undergoes arterialization (206); it is then conveyed into the left auricle and ventricle, and from thence through the aorta to all parts of the body, from which it is again returned by the same channels; this constitutes the *general circulation* in the adult.

214. The *fœtal circulation* differs from the general, inasmuch as the blood becomes fitted for the nutrition of the child, not by acquiring fresh properties from the air, but by its return to the placenta, from which source a fresh supply is obtained. In the first place, the umbilical vein conveys arterial blood from the placenta through the umbilicus of the child to the umbilical or longitudinal fissure; having arrived at the transverse fissure it divides into two veins, one of which mingles with the vena porta, circulates through the liver, and, by means of the *venæ cavæ hepaticæ*, pours its blood into the ascending cava; the other branch, called *ductus venosus*, passes in a fissure of the same name, to the vena cava; the blood is

then conveyed along the cava to the right auricle, and from thence to the left auricle through the *foramen ovale;* it then passes into the left ventricle, and along the aorta and its branches, as in the adult; the blood from the head and upper extremities is returned by the vena cava descendens to the right auricle, but the current passing in a different direction to that in the ascending cava, is conveyed to the right ventricle, and from thence into the pulmonary artery; after passing along this vessel to the point where it bifurcates, the principal portion is conveyed by the *ductus arteriosus,* which becomes ligamentous after birth, to the aorta, where it mingles with the other blood. At the bifurcation of the iliacs the principal portion of the blood is conveyed along the internal iliac, which, in the fœtus, is much larger than the external, and from the summit of the bladder, by the continuation of these arteries called hypogastrics, to the umbilicus, where they coil round the vein and form the umbilical cord, and thus to the placenta. The blood in the external iliacs circulates to the lower extremities, and is returned in a similar way to that in the adult. The eyes are the first evident parts of the fœtus, and are produced in the first month; about the end of the third month muscular fibres are perceived, and at the time of birth the weight is about seven pounds and a half.

215. The *liver* forms an important part in preparing the blood for *fœtal nutrition*; it is the

largest organ before birth, and pours a secretion called meconium into the intestines, which is voided after birth, and which is probably removed from the blood, as being unfitted for circulation in the fœtus, the liver before birth thus performing the function which the lung does after.

216. Each *contraction* of the ventricles probably propels about *two ounces* of blood in each vessel, and the same force conveys this blood along the larger ones, but the *contractility* of the coats of the arteries materially assists in sending it to its final distribution. In *childhood* the *pulse* beats 140 in a minute, but at the age of puberty not more than 78 or 80; as age increases, so the pulse diminishes in frequency, till at length it is not more than 50 in a minute; it is also more frequent in inhabitants of warm climates.

The number of *inspirations* in a minute is 15 or 18; about one-fourth of the heart's contractions. The quantity of air *inspired* each time is about 17 cubic inches, according to Sir H. Davy, but more than double that quantity in forced inspiration. After ordinary *expiration* there is still left a considerable quantity of air in the chest, which enables us to expel any substance from the glottis; and this causes the quantity of air *expired* to be less in quantity than that *inspired*.

217. The *atmosphere* consists of 79 nitrogen, and 20 per cent. oxygen, but after inspiration this is found to be deprived of eight parts of its oxygen whose place is supplied by carbonic acid, but r

equal to the oxygen displaced. The nitrogen undergoes little or no change, its use being to dilute the oxygen, which, in its pure state, is dangerous to inhale.

218. *Wounds* of the *chest* may be *superficial;* or those *penetrating* into the pleura costalis, into the substance of the lungs, into the heart, or into some of the great vessels; they may give rise to *emphysema, inflammation,* and *empyema, collapse of the lung, internal hæmorrhage,* or *pneumothorax.*

In gunshot or sabre wounds of the chest there is great danger; but Hennen observes, "that great hopes may be held out if the patient survives the third day, since the most fatal hæmorrhages occur in the first forty-eight hours."

219. The *symptoms* of *internal hæmorrhage* are —difficulty of breathing, expectoration of blood, great anxiety, sinking of the pulse with intermission, dull sound on percussion, gurgling sound on auscultation, coldness of extremities, pallid countenance, and general collapse. When the bleeding takes place from a large artery, the patient dies quickly; but if only a small vessel is wounded, the hæmorrhage may cease of itself, or the vessel from which it arises may be tied.

220. *Emphysema* is distinguished from other *swellings* by the crackling sensation felt on *pressure.*

In pneumothorax there is sense of suffocation, *lividity of* countenance, dulness on percussion, indistinct respiratory murmur, or total cessation of it, and collapse.

Wounds penetrating the heart generally prove fatal either by the bleeding, by the inflammatory action, or by the shock to the nervous system.

221. In *gunshot wounds* of the chest there is great prostration, quickly succeeded by inflammatory symptoms. If there are two wounds, one with inverted and the other with everted edges, it is probable that the bullet has passed out of the chest; but if there is only one opening, it is almost certain that the bullet still remains within, as the cases in which it has escaped at the same aperture, after passing round the parietes, are very rare.

222. The branches which the *thoracic aorta* gives off between the termination of the arch and its passage through the diaphragm, are—the pulmonary or bronchial branches, which pass to the roots of the lungs, and are destined for supplying those organs with blood; the œsophageal, ramifying upon the œsophagus, and the intercostals, which are in general nine in number, running on the inferior grooves in the ribs (38), and anastomosing with the anterior intercostals, the three upper ribs being supplied by superior intercostal from subclavian (189). *Bleeding from one of these arteries* generally proves very dangerous, especially if it be near the origin, as the difficulty *of getting* at it is great; in such cases the same *treatment* that is adopted in bleeding from the *lungs* must be pursued.

223. *Before birth*, the lungs are dense, of a reddish-brown colour, and solid, and there is very little blood in the pulmonary arteries; but *after the child has respired*, the lung is inflated, fills the thorax, and is less deep in colour; the pulmonary artery is filled with venous blood, and the ductus venosus and ductus arteriosus are in a collapsed state, and nearly empty. Also, *before birth*, the blood in the veins and arteries is very similar; but after birth, that in the arteries acquires a brighter colour.

If the lung of a child which has respired be placed in water, it floats, whilst that of a stillborn infant sinks; but as artificial respiration or putrefaction may have conveyed sufficient air to the lung to inflate it, it is necessary to be able to distinguish between them, and this is effected by the knowledge that putrefaction affects the surface first. By pressing the lung where putrefaction has commenced, the whole of the air is expelled and the lung sinks, but no force can expel the air of a lung which natural respiration has distended: this test is called the hydrostatic test, but is not to be depended on.

223 *bis*. *The mamma*, or *breasts*, consist of numerous lobules bound together by tough cellular tissue, and having a quantity of fat interspersed between them. Each lobule is abundantly supplied with bloodvessels and has a separate *galactophorous duct*. These last converge towards the *nipple*, and beneath the *areola* become straight

and somewhat dilated, so as to form sinuses. The *diseases* to which the gland is subject are *hypertrophy*, *acute* and *chronic inflammation*, *neuralgia*; *hydatid disease*, *glandular tumour*, *cancer*. *Acute mastitis* occurs at any period during lactation; and should be treated by mild purgatives, fomentation, support, and when fluctuation is felt, punctured; *glandular tumour* (also called *chronic mammary*, or *sero-cystic, adenocele*) consists of a development of gland tissue, hypertrophy of the fibrous tissue and formation of fibro-plastic matter. Cysts are formed in the meshes of the interstitial tissue filled with fluid. Generally results in removal; bowels and menstrual functions should be attended to in early stage. *Cancer* is generally of the hard or scirrhous variety, occasionally medullary: retraction of nipple an important symptom. The earlier the removal the best chance for the patient. *Lacteal calculus* is a condition in which the earthy salts of the milk form small concretions.

CHAPTER X.

ON THE ANATOMY AND SURGERY OF THE ABDOMEN.

224. THIS is the largest of the cavities, and *contains* the organs of digestion, a portion of those for the secretion of urine, and for generation: the functions and structure of these organs would suffer from compression, and therefore the parietes are almost entirely muscular, but of great dilatation; protection is afforded by the hands, which are naturally or instinctively thrown forward when danger presents.

The *boundaries* are *superiorly*, the diaphragm; *anteriorly* and *laterally*, the abdominal muscles and ribs; *posteriorly*, the lumbar vertebræ and quadratus lumborum muscle; and *inferiorly*, the false pelvis and the organs contained in the true one.

The *regions* are nine in number; they are marked out by two imaginary lines drawn perpendicularly downwards from the eighth rib to the middle of Poupart's ligament; by one, carried horizontally across from the most prominent rib on one side to the corresponding one on the opposite; and by another, from the anterior superior spinous process of one ilium to that of the other. The *upper and central region*, which is called *epigastric* (ἐπὶ above, γάστηρ the abdomen) contains the pyloric half of the stomach, the left lobe of the liver with the lobulus Spigelii, the upper edge of the pancreas, the cæliac axis with the surrounding semilunar ganglia, the aorta, vena cava *ascendens*, thoracic duct, vena azygos, crura of the *diaphragm*, hepatic artery, vena porta, and splenic *vessels*.

The upper and right space, called right hypo-

chondriac region (ὑπὸ under, χόνδρος a cartilage), contains right lobe of liver, gall-bladder, right transverse colon, ascending portion of duodenum, hepatic duct, and vessels entering liver. The *left hypochondriac region* contains fundus of stomach, splenic omentum, vessels, and spleen, smaller end of pancreas, left transverse colon, and vessels.

The *umbilical region*, extending round the umbilicus, contains omentum, mesentery, with lacteals and glands, transverse portion of duodenum, and jejunum, pancreas, aorta, vena cava, receptaculum chyli, and vena azygos.

The *right lumbar region*, situated on the right side of umbilical, contains ascending colon, kidney, with renal capsule, some convolutions of jejunum, and descending portion of duodenum.

The *left lumbar region* contains descending colon, left kidney, renal capsule, and convolutions of small intestine.

The *hypogastric* (ὑπὸ under, γαστὴρ the abdomen), situated in the median line, but beneath the umbilicus, contains convolutions of jejunum and ileum, bladder when distended, sigmoid flexure of colon, and commencement of rectum, uterus during pregnancy, and vessels.

The *right iliac*, on right side of hypogastric, contains cæcum, appendix vermiformis, termination of ileum, ureter, spermatic vessels, and vas deferens.

The left iliac contains sigmoid flexure of colon, *ureter, vas* deferens, and spermatic vessels.

225. The *peritoneum* is separated from the internal surface of the abdominal muscles only by the fascia transversalis; on tracing it upwards, it passes along the under surface of the diaphragm for some distance, from which it is reflected on to the convex surface of liver, forming, in centre, *coronary*, and on the side *lateral ligaments;* passing along to the sharp anterior margin it covers the under surface till it arrives at the transverse fissure, from whence it is reflected down to the upper edge of stomach and first portion of duodenum, forming *anterior layer of lesser omentum;* on the *posterior* surface of the liver, peritoneum is also found, and by following its course along the under surface of that organ, as far forward as the transverse fissure, it is seen to form the *posterior portion of the lesser omentum;* these two layers pass in front and behind the stomach and first part of duodenum, and after enclosing them, are carried down to the lower part of abdomen, from whence they are reflected upwards to the transverse arch of the colon, forming the *great omentum;* after enclosing this intestine they pass back towards the spine under the name of *transverse meso-colon,* then separate, and leave in the space between them the third portion of the duodenum and pancreas; the upper layer, passing on to the posterior part of the diaphragm, forms the *posterior layer of coronary and lateral ligaments,* and is then seen to be continuous with that portion covering the back of

the liver; the under is reflected forwards again, under the name of *mesentery*, to enclose the jejunum and ileum, after doing which, it again passes to the spine as the posterior layer of the same fold; from this part it is carried down into the pelvis surrounding the upper third of the rectum, and attaching it to sacrum by a fold, called *meso-rectum;* it then passes along the front of the middle portion of this intestine, and leaving the inferior third uncovered, passes on to the fundus or base of the bladder; it covers the posterior or lateral parts of this organ, as far upwards as the apex, from which it is reflected upon the obliterated hypogastric arteries and the urachus, to the point from whence we started—namely, the abdominal muscles.

At the right extremity of the lesser omentum, where the duodenum turns downwards, the posterior fold of the peritoneum is reflected upwards to the liver, leaving the posterior of the middle portion of duodenum totally uncovered: the aperture here described is the *foramen of Winslow;* the relations of which are, *in front*, the vena porta, ductus communis choledochus, hepatic arteries, and lymphatics; *above*, the lobus Spigelii of the liver; *behind*, the right crus of diaphragm, and the vena cava ascendens; *below*, the hepatic artery. Tracing the peritoneum *laterally* from the abdominal muscles, it is found to be *reflected* some little distance from the sides of *vertebræ* on to the ascending and descending colon, forming an ascending and descending *colic omentum;* as the commencement of the colon or cæcum lies close to the parietes, there is no peritoneal fold at its posterior part, and this must be remembered, as in hernia it accounts for the *absence of sac* when such portion protrudes. From the left extremity of the stomach, the peritoneum is reflected over the spleen, and at its posterior aspect becomes continuous with that on the back of the diaphragm.

The organs which are left uncovered by this membrane are, kidneys, posterior of middle and third portion of duodenum, portion of gall bladder, pancreas, commencement of colon, posterior of middle and whole of inferior third of rectum, and the anterior and inferior half of bladder.

226. The *parts successively pierced* by a weapon passed in, from the front of the abdomen, below the umbilicus, would be—the three layers of the skin, the fascia transversalis, the peritoneum lining the muscles, the four layers of the great omentum, the peritoneum covering the intestines, the muscular and mucous coats of the same, the mesentery, the great vessels, and the vertebræ.

THE ALIMENTARY CANAL.

227. Commencing at the mouth, and terminating only at the anus, consists of a tube which differs not only in structure and in size at different parts, but also in function. The same lining mem-

brane, however, is continued throughout, and at each extremity is continuous with the skin, as in all other cavities which open externally, the only perceptible difference being the absence of epidermis in mucous membranes.

This tissue possesses, in a remarkable degree, the power of absorption and secretion, and in disease is characterized by symptoms which distinguish it from other membranes, such as the suppurative and ulcerative process, in which inflammation of it generally ends; whilst that of serous membrane generally terminates in adhesion or effusion.

228. From the lower border of the fifth cervical vertebra, where the pharynx ends, the *œsophagus* extends down to the cardiac orifice of the stomach, lying in the posterior mediastinum (202); it is muscular externally, and lined by mucous membrane. In this, as throughout the whole of the alimentary canal, the circular fibres are internal, and are the principal agents in propelling the food downwards by their peristaltic action.

THE STOMACH.

229. A *musculo-membranous viscus*, of a conical shape, has two openings, three coats, two curvatures, and two surfaces; in an empty state its anterior surface looks forward, its posterior backwards, but when distended, the lower part *rises toward* the walls of the abdomen, and the *two apertures* are then directed backwards: the

left portion, or larger end, is called *fundus*, and is supposed to be the part where digestion is carried on most actively; the *cardiac* orifice is a simple opening of the œsophagus into it, but the *pylorus* (πίλη porta, οὖρος custos), is a distinct valve, formed by a thickening of the circular muscular fibres; this orifice lies near to the under surface of the liver. The *external coat* is formed by the anterior layer of the lesser omentum, and as it is reflected both on and off at the curvatures, it admits of great distension taking place; the *middle coat* is *muscular;* its fibres are arranged in three directions; the *longitudinal* are most evident at the lesser and greater curvatures and external; the *circular* are continuous at one orifice with those of the œsophagus, at the other they form the pyloric valve; the *transverse* or *oblique fibres* decussate with the circular, and are most evident at the fundus; the *internal* coat is mucous, and presents on its inner surface innumerable papillæ or villi, from which appearance it is named villous. Many anatomists assign a fourth coat to the stomach—the fibrous coat: it lies between the muscular and mucous coats, and strengthens the organ considerably. The *vessels* which ramify on it are, *along its lesser curvature*—viz., for about three inches,—the gastric and the superior pyloric *from the* hepatic; *along its greater*, the gastro-*epiploica* dextra from gastro-duodenalis, and the *gastro-epiploica* sinistra from splenic; the nerves *are the* right and left pneumogastric, and branches *from the* solar plexus.

230. The gastric juice is secreted in the stomach, most copiously at the fundus, and mingling with the food, converts it into *chyme;* the hydrochloric acid which it contains possesses powerful antiseptic and solvent properties, both of which are brought into action during digestion; numerous glands, or mucous follicles, are seen on the mucous coat, and are called Brunner's or solitary glands, and there are also numerous follicles seen here and along the whole of the intestinal tube, called *glands of Lieberkühn.*

231. From the pylorus to the commencement of the colon in the right iliac fossa, extend *the small intestines,* forming about *five-sixths* of the whole canal, which is about thirty feet in length. From the right iliac fossa to the anus is situated the *large intestine,* forming about one-sixth. Both these portions are larger at their commencement than at their termination, and end in valves.

232. The *duodenum,* about twelve fingers' breadth in length, forms a curve, and extends from the pylorus on the left side of the second lumbar vertebra; its outer coat is partial, covering only the first portion, and front of second; the *circular* fibres of the middle coat are most evident, and on the inner coat are seen the folds called *valvulæ conniventes;* in its curvature lies the *head of the pancreas,* and opening into its posterior surface, near the junction of the second and third portion, *are the ductus* pancreaticus, and the ductus *communis* choledochus, which pass for some distance

obliquely through the coats before terminating. Its artery is the pancreatico-duodenalis from the hepatic.

233. The *jejunum* and *ileum* form the remainder of the small intestine, and of these the *jejunum* forms *two-thirds*; this portion is named from the state in which it is found after death, and has more dense walls than the ileum: the *valvulæ conniventes* are numerous at its commencement, but diminish in number down to the ileum, where they are no longer seen, but in their place are found the *glands of Peyer*, or glandulæ aggregatæ.

234. The *ileum* opens into the side of the colon, from which it is separated by the *ileo colic* and *ileo cæcal valves*, folds of mucous membrane, which tend to prevent the contents of the large intestine passing back to the ileum. These two portions of intestine are enclosed in the *mesentery*, which admits of free passage for the lacteals and for the left branches of superior mesenteric artery.

235. The *cæcum* is that portion of large intestine which is below the opening of the ileum, and lies in the right iliac fossa; from it, extending down into the pelvis, and lying on the iliac artery, is the *appendix vermiformis*, composed of a *mucous pouch* and longitudinal muscular fibres: above the valve the intestine is called colon, and after forming the arch, terminates in the left iliac fossa by the sigmoid flexure, beyond which is the

rectum, extending from promontory of sacrum to anus: the *peritoneum* covers the large intestine, except at the commencement and termination: the longitudinal muscular fibres are arranged in three pillars, and as they are shorter than the intestine itself, the latter is drawn into pouches. In the *rectum*, the longitudinal fibres are extended *round* the intestine, become circular, and at the anus *mingle* with the external *sphincter ani*; the circular fibres are not evident in the colon, but are found in the rectum, especially at the anus, where they form the internal sphincter.

236. On the *peritoneal* coat of the large intestines are seen the *appendices epiploicæ*; on the *mucous coat*, open some of the lacteals, less numerous than in the small, but extending down to the rectum; advantage is taken of this where there is inability of swallowing, by giving nourishment by enemata; the formation of scybala also occurs from the absorption which is continually going on through these vessels. The *ascending* and one-half the *transverse colon* are supplied by the colica dextra and media from the superior mesenteric; the left half of transverse and the *descending colon*, from the colica sinistra of the inferior mesenteric, and the *rectum* from the three hæmorrhoidal arteries, derived from inferior mesenteric, internal iliac, and pudic.

The whole course of the intestine is supplied by *branches from* the solar plexus and the abdominal *ganglia of* the sympathetic nerve. These form *numerous* plexuses, which surround the arteri are distributed with them, and are named from them.

237. The *liver* lies in the right hypochondrium and epigastric region; it contains *five* lobes—viz., right, left, lobulus Spigelii, lobulus quadratus, and lobulus caudatus; *five fissures* or notches, one transverse for portal vein, hepatic arteries, nerves, and ducts, four longitudinal, for umbilical vein, for gall bladder, for ductus venosus, and for vena cava; *five ligaments*, coronary, two lateral, falciform, and teres; *five kinds of vessels*, the hepatic artery and vein, the vena porta, the hepatic duct, and the absorbents: there are also superficial depressions on its under surface for the transverse colon and stomach.

It is of a dark red colour, weighs between three and four pounds, has a peritoneal coat, and a fibrous covering called *capsule of Glisson*, and is in lateral diameter about twelve inches; its posterior border is thick and rounded, its anterior sharp, its upper surface convex, and its inferior concave; at the *transverse fissure* the capsule enters together with the *vena porta* and *hepatic artery*, and is continued into all parts of its structure, acting like the pia mater to the brain, and forming round the portal vessels, *sheaths*, called *vaginal sheaths*, and round each of the *lobules* or *acini*, envelopes: the lobular bodies are found in all parts of the organ, but in the centre are of an angular shape, while towards the circumference they acquire a more rounded form; running down their middle is the *intra-lobular vein,* into which still more minute branches pour their blood; at the base of the lobules these veins open into a larger one, called *sublobular;* several of these join together, and by their union at length form the *hepatic vein,* which terminates in the vena cava; around the intra-lobular vein ramify the vena porta, the ductus hepaticus, and hepatic artery, external to which is the capsular covering; in passing to and from these lobules, the vessels ramify between them and form *interlobular vessels;* the *portal vein* in the *vaginal sheaths* gives off numerous branches which, previous to entering between the lobules, form the *vaginal plexuses.*

238. The *vena porta* formed by the union of the *splenic* and *superior mesenteric vein,* into which those from all the chylopoietic viscera open, passes from the upper and posterior border of the pancreas to the transverse fissure of the liver, and in the lobules gives off the biliary secretion; this enters the hepatic duct by *exudation,* and is conveyed along the lesser omentum to the duodenum; the residue of the blood from the vena porta then passes into the *intra-lobular vein,* and finally mingles with that in the *cava:* the blood in this vein is much thicker and darker than that in others; the hepatic artery is destined to supply the lobules with blood for their nutrition, after doing which it terminates in the intra-lobular vein.

239. *Bile* consists of picromel, cholesterine, *osmazome,* salts of soda and potash, cholic aci

and resin; the first and last have much affinity for each other, and these substances form the essential parts of the bile, by some being considered synonymous. Berzelius and Mulder suppose that a neutral organic substance, bilin, forms the most important constituent; Liebig, that certain organic acids are united with soda to form fatty salts. The liver elaborates *glycogen*, which is capable of passing very readily into a kind of sugar called *glycose*, which is carried off in one shape or other by the blood. It is also probable that the liver is one source of the colourless corpuscles of the blood.

Biliary calculi consist of yellow colouring matter, cholesterine, margarine, and margarates. Gall stones contain inspissated bile.

240. The relative position of the vessels in the lesser omentum is—*to the right*, the ductus communis choledochus, surrounded by the capsule of Glisson; *to the left*, the hepatic artery, between and behind the vena porta.

241. The *gall bladder* is a membranous sac of a pyriform shape, lying in a groove on the under surface of right lobe of liver; it has a peritoneal coat, which is not complete, and a perfect lining mucous membrane, which at the cystic duct joins the hepatic at an angle, and forms the ductus communis choledochus.

The bile which is found in this reservoir passes *into it by the* cystic duct; it is bitter, pungent, *and viscid*, whilst that in the hepatic duct is bland *and harmless*.

242. The *spleen*, situated in the left hypochondrium, resembles, in appearance, the *placenta;* it is highly vascular, and at its concave side, which faces the stomach, has a fissure, called *hilus*, at which the splenic artery from the hepatic enters and the splenic vein emerges, both of these vessels being of large size; it is supplied with nerves from the solar plexus, and has numerous absorbents. The spleen has no duct. There are many theories as to its function, and as the blood of the splenic vein is found to contain proportionally fewer red corpuscles, but more colourless, and more fibrin, than the splenic artery, it has been supposed that the spleen is one of those parts of the economy in which the colourless corpuscles are especially produced.

243. The *pancreas*, one of the conglomerate glands, resembles, both in appearance and function, the salivary glands; it is of a pale ash colour, about six inches in length, situated in the curvature of the duodenum, and extending into the left hypochondrium; towards its lower border and on its posterior surface is a duct, which proceeds from its left or smaller end towards the head or right extremity; this duct collects, from little mucous cells formed on its ramifications, the pancreatic secretion, which it pours into the duodenum (232).

The arteries of this gland are, the pancreaticus magnus from the splenic, branches from the pancreatico-duodenalis, and from the mesenteric; its nerves are derived from the solar plexus.

The pancreatic secretion does not contain any sulphocyanate of potash, but in other respects closely resembles saliva.

244. The *kidneys*, (renes, νεφροι), two in number, are placed upon the pillars of the diaphragm and on the quadratus lumborum, opposite to the two last dorsal and two first lumbar vertebræ, the right being a little lower than the other.

In *shape* they are oval, rather larger above than below, convex externally and anteriorly, flat posteriorly, and concave on the side nearest the median line; their colour is dark-red; they are about four inches in length, two in breadth, surmounted by the capsule, and separated from the peritoneum on the right side by the duodenum and ascending colon, on the left by the descending colon.

There is a *proper fibrous capsule* which invests it, and which is continuous with the external coat of the ureter, but *no peritoneal covering*. The external circumference of its structure is *cortical*, and is composed of ramifications of the renal arteries, renal veins, lesser splanchnic nerves, numerous absorbents, corpora Malpighiana, and cellular tissue; internal to this is placed the medullary structure, composed of conical-shaped tubular portions, the apices of which all look towards the hilus, where the pelvis is placed; these tubular bodies, of a dark and dense appearance, consist of the tubuli uriniferi, which commence at the base in the corpora Malpighiana, and at the apex, or *mammary process*, empty themselves into the infundibula; the union of these last form the pelvis.

The lining mucous membrane of the ureter is continued upwards into the pelvis, and from thence into the infundibula; it is reflected over the mammary processes, taking the name of *calyx;* lines the numerous tubuli uriniferi, and at the base of the tubular portion expands into the corpora Malpighiana; these, then, are most probably the secreting surfaces, where the urine is separated from the surrounding arteries by capillary absorption.

245. The *ureter* is a tube of the diameter of a quill, and of eighteen inches in length; it is composed of two coats, one continuous with the mucous, the other with the fibrous coat of the kidney above, and terminating below at the posterior angles of the trigone vesicæ in the bladder; in this course it lies on the psoas magnus muscle, crosses over the common iliac arteries, and runs for some distance between the coats of the bladder before terminating; the vas deferens crosses to its inner side just before its termination: the spermatic vessels cross in front also, but higher up; it lies behind the peritoneum in its whole course.

246. The *renal capsules* which surmount the kidneys are small granular bodies, somewhat conical in shape; during *fœtal existence* they are twice as large as the kidney, but after birth they diminish in size; they are furnished with a supra-renal branch from the aorta, and by nerves from the

renal plexus, and from the phrenic. The *relative position* of vessels at their entrance into the kidney is, vein in front, artery intermediate, and pelvis of ureter posteriorly.

247. The *abdominal aorta* extends from the crura of diaphragm to fourth lumbar vertebra, where it bifurcates into the two iliacs; at its commencement it lies nearly upon the centre of the bodies of the vertebræ, but gradually inclines over to the left side. To its right lies the vena cava ascendens; opposite the third lumbar vertebra the receptaculum chyli lies to the left, but above that crosses behind, to the right side of it; near its upper part the vena azygos lies to its right; the liver, pancreas, duodenum, left renal vein, and mesenteric artery, all lie in front; its *branches* are the phrenics, the capsular, the supra-renal, the renal, spermatics, and lumbar, given off in pairs: the cœliac axis, superior and inferior mesenteric, and sacra media, given off singly.

The *phrenics* ramify around the aponeurosis of the diaphragm. The *cœliac axis*, a short trunk from the front of the artery, below the preceding and surrounded by the semilunar ganglia, divides into—1st, *gastric*, which terminates in an œsophageal branch, and the coronaria ventriculi, ramifying along the lesser curvature of the stomach; 2nd, *hepatic*, the largest in the fœtus, which gives off the pyloric to anastomose with the coronarii ventriculi; the gastro-duodenalis dividing into pancreatico-duodenalis to the duodenum and pancreas, and gastro-epiploica dextra to the greater curvature of the stomach, the posterior or inferior pyloric, the cystic, and the terminating branches; 3rd, *splenic*, the largest in the adult, passes along the upper border of pancreas to fissure of spleen, where it terminates by entering that organ; it gives off the pancreatic, gastro-epiploica sinistra ramifying along the greater curvature and anastomosing with gastro-epiploica dextra, and vasa brevia to fundus of stomach.

The *superior mesenteric* arises a little below the cœliac axis, passes between the pancreas and third portion of duodenum, and runs down in the mesentery towards right iliac fossa; from its convex or left side, it gives off about twenty branches to the small intestines, which, after forming arches, ramify *round* them; from its right, or concave side, it gives off the colica media, colica dextra, and ileo colic: these anastomose with each other, and supply the caput coli, ascending and transverse colon.

The *supra-renal* arteries arise on the level of the preceding, and are distributed to the capsules.

The *renal*, beneath these, pass to the kidneys; the right is the longest; they pass between the tubular portions to arrive at the cortical structure.

The *spermatics* are small in size, and follow *the* descent of the testicle; they pass over the *ureters*, psoas muscles, external iliac artery, and down the inguinal canal, forming part of the spermatic cord, to the tubular portion of the testis. The right frequently arises from the right renal.

The *inferior mesenteric* arises from aorta about one inch above its termination, passes into left iliac fossa in left colic omentum, and gives off colica sinistra, sigmoid branches, and superior hæmorrhoidal.

Sacra media, given off at bifurcation of aorta, passes down centre of sacrum.

The five pair of lumbar from posterior surface pass to the abdominal and lumbar muscles spinal cord and membranes, keeping up a constant anastomosis with intercostals above and lumbar branches of internal iliac below.

248. *Digestion* is carried on along the whole course of the alimentary canal, commencing in the process of mastication and terminating only in the excretion of fæculent matter at the anus.

In *mastication* the relaxation of the temporal, masseteric, and pterygoid muscles, the action of those which are attached to the os hyoides, and the weight of the lower jaw, open the mouth for the entrance of food; after being submitted to division and separation by the teeth, which are brought into motion by the temporal, masseter, internal and external pterygoid, and moved from side to side by the buccinator and tongue, the food is then mingled with the secretion from the salivary glands: having undergone sufficient amalgamation, it is conveyed to the pharynx by the tongue; at this period (the jaw forming a fixed point) the genio-hyoglossus, the genio-hyoideus, the mylo-hyoideus, the stylo-hyoideus, and pharyngeus, the digastric and middle constrictor, raise the larynx (194), and the food is conveyed down the pharynx and œsophagus by the successive contraction of their muscular fibres, mingling in its passage with the secretions of the tonsils and the different mucous glands: having passed into the stomach, it is submitted to the action of the gastric juice (230), and this constitutes *chymification;* when sufficiently acted upon by this fluid, it is propelled by the muscular fibres through the pylorus to the duodenum: for some time this valve will resist the passage of undigested food, but after a time loses its power, and allows of considerable-sized substances passing through. When, from disease or from too great irritation, the muscular fibres act from below upwards, the food is again passed into the œsophagus and mouth, and *vomiting* takes place: in this action, the abdominal muscles unite, and the diaphragm becomes relaxed; that such is the case seems to be confirmed by finding that birds of prey, which have no diaphragm, vomit with great facility, and that the two circular bands of muscular fibre which surround the cardiac orifice in the stomach of the horse, render it almost impossible in that *animal.*

Chylifaction commences in the duodenum, and is the separation of the albuminous portion occasioned by mingling with the bile and pancreatic fluid: the valvulæ conniventes delay the passage through this intestine, and by their folds offer an additional surface for the food to come in contact with the lacteals, which are very numerous in this and the other small intestines. By chemical action, the chyle or albumen is separated, and by absorption is carried along the lacteals to the receptaculum chyli, while the excrementitious portion is conveyed along by the peristaltic action of the muscular fibres; when, by the removal of the whole of the chyle, or by partial decomposition taking place, it becomes feculent matter, and has been conveyed to the rectum, relaxation of the sphincters at the anus takes place and allows of its exit. The ileo-colic and ileo-cæcal valves prevent regurgitation into the ileum without great efforts, and the direction of the colon tends to delay the passage of the contents through it, and enables it to be more thoroughly submitted to the action of the absorbents. The bile seems to form the natural purgative of the bowels, as its absence, denoted by clay-coloured fæces, occasions constipation.

249. The *secretions* poured into the alimentary canal, along its whole course, are—saliva, mucus from numerous glands extended over the whole length, gastric juice, bile, pancreatic fluid, and a secretion from the follicles in the colon, which seems to assist in communicating odour to the fæces.

250. In *wounds* of the abdomen, the danger depends on the part injured, on the extent of the wound, on extravasation, on the age of the patient, and on the nature of the wound, whether incised, bruised, or gunshot. When the *coats* of an *intestine* are *lacerated*, there is much danger from inflammation and mortification; and there is more to be feared from this than from any escape of the food, the omentum and abdominal muscles tending to prevent this. If the injury has occurred in the stomach, or small intestine, there is more danger than in the large, as the former are more plentifully supplied with nerves.

251. *Wounds* of the *liver* and *gall-bladder*, if of any extent, generally prove fatal, and *wounds* of the *ducts* and *spleen* are also highly dangerous. It may be mentioned that in many severe injuries of the abdominal viscera, no external wound is to be detected.

252. Extravasation from the wounding of vessels greatly increases the danger, and renders the prognosis unfavourable.

253. Great diversity of opinion exists as to the propriety of applying ligatures in a wounded intestine, and if the wound is not very large, or not protruding, it is wrong so to do. When the wounded or protruding bowel is in a state of mortification, attempts to establish a false anus must be made. As the principal danger in wounds of the abdomen is inflammation, the treatment must be strictly antiphlogistic, and great caution mus

be used in adopting any remedies which are likely to increase it, such as the exhibition of purgatives, or the administering of solid food. Glysters for the purpose of emptying the intestine, and for supplying nourishment to the patient, are very appropriate.

Aneurisms sometimes occur in the abdominal aorta, and attain considerable size. By relaxing the abdominal muscles, especially in a thin person, they may be felt, but little can be done for them, as they generally are the consequence of osseous deposit in the coats, and are found in other parts at the same time.

CHAPTER XI.

ON THE MUSCLES OF THE ABDOMEN, AND HERNIA.

254. There are five pairs of *muscles* in front and on the sides of the abdomen, and two pairs at the back; those in *front* are, the obliquus externus descendens, the obliquus internus ascendens, and the transversalis abdominis, the rectus and pyramidalis; those *behind* are the quadratus lumborum, and the latissimus dorsi.

255. The *obliquus externus* descendens, situated *beneath* the skin, superficial fascia, and fat, *arises from* external surfaces of eight or nine

inferior ribs; the five superior fleshy portions indigitating with serratus magnus, the three inferior with latissimus dorsi; *is inserted* into anterior two-thirds of outer brim of crest of ilium, into spine of pubes, symphysis of same, and linea ilio-pectinea, forming Gimbernat's ligament; its anterior fibres pass forward and unite with the muscle of opposite side to form linea alba, which extends from symphysis to ensiform cartilage; between the anterior-superior spine of ilium and spine of pubes, the lower portion of its aponeurotic fibres are extended to form Poupart's ligament; near the pubes some are continued across the linea alba to the crest of the opposite pubes, forming the *triangular ligament.*

256. *Obliquus internus ascendens* arises from rather more than outer half of Poupart's ligament —from anterior three-fourths of middle of crest of ilium, and from lumbar of fascia; is inserted into linea ilio-pectinea, crest and symphysis pubis, linea alba, and lower edges of cartilages of seven or eight lower ribs; at the outer border of rectus its aponeurosis splits into two layers, and encloses this muscle for the upper four-fifths; at the lower part, together with the transversalis, it passes in front of rectus.

257. *Transversalis* arises from internal surfaces of six or seven lower ribs, indigitating with *diaphragm*, from lumbar fascia, from anterior *three-fourths* of inner brim of crest of ilium, and *from* rather less than half of Poupart's ligament.

is inserted into linea ilio-pectinea, crest and symphysis pubis, and whole extent of linea alba.

258. *Rectus abdominis* arises from symphysis and crest; becomes broader as it ascends, and *is inserted* into ensiform cartilage, and into fifth, sixth, and seventh ribs; it is marked by three or four lineæ transversæ, and is enclosed in the sheath except at its lower part.

259. *Pyramidalis,* a small muscle, superficial to the preceding, extends from crest of pubes to linea alba, for about two inches from the symphysis.

260. *Quadratus lumborum* arises from posterior fourth of crest of ilium; *is inserted* into last rib, and by tendinous fibres into transverse processes of four superior lumbar vertebræ.

261. The *external abdominal ring* is the interval left between the fibres of the external oblique as they split to go to their insertions in the symphysis and spine of the pubes; its base is formed by the crest; its sides by the fibres of the oblique, which are called pillars; the inner one of which is ribbon-shaped, and the outer sickle-shaped, and has the cord or round ligament resting on it; its upper angle is rounded off by the intercolumnar bands which extend upwards towards the umbilicus. It is *bounded* in *front by* the skin, common superficial fascia of the body, *and by the* spermatic fascia, which is sent down *from the* intercolumnar bands; the internal pillar of it *is* not only internal, but from the oblique

direction of the opening, is superior, and slightly anterior; it is *bounded behind* by the triangular fascia or ligament, by the conjoined tendon of internal oblique and transversalis, and by transversalis fascia.

Through this opening pass the spermatic cord and cremaster in the male, and round ligament in the female.

262. The *internal ring* is situated midway between the spine of the pubes and anterior spine of ilium, and half an inch above Poupart's ligament; it is formed by the spermatic cord carrying down a funnel-shaped portion of the fascia transversalis (infundibuliform fascia), immediately beneath the fibres of the transversalis muscle.

263. The *inguinal canal* is the space between the two rings, and is about two inches in length; it has in *front*, the obliquus externus; *below*, Poupart's ligament; *behind*, proceeding downward from internal ring, the fascia transversalis, epigastric artery, and conjoined tendon of internal oblique and transversalis; *above*, it has some fibres of the internal oblique, and the lower margin of the transversalis arching over it.

The *fascia superficialis* adheres closely to the fascia lata a short distance beneath Poupart's ligament, and below it passes across the falciform opening to form the *cribriform fascia*.

264. The *fascia transversalis* lines the abdominal muscles; opposite the crest and Poupart's *ligament*, it passes on to the iliacus and psoas

muscles, where it is called *fascia iliaca;* at the brim of the pelvis it is continued down that cavity as fascia pelvica, till, meeting with the levator ani muscle, it splits into two layers, an internal, reflected over the rectum and bladder, called *recto-vesical,* and an outer, called *obturator fascia,* the levator ani arising between the two fasciæ. The point where the pelvic fascia splits is called the *white line;* the pelvic fascia also appears in the ischio rectal fossa as *anal,* covering levator ani, and as a sheath for the internal pudic vessels and nerves as they re-enter the pelvis; this latter is derived from the obturator fascia; it is directed on to the bladder, constituting the true ligaments of the bladder; in front of this viscus it is continuous with the fascia transversalis of the abdominal muscles.

When this fascia protrudes either in direct, oblique, or femoral hernia, it is called *fascia propria,* and in the natural state it is called fascia propria where it covers the cord in the inguinal canal, and where it forms the sheath for the femoral vessels beneath Poupart's ligament. The upper layer of the sheath of the vessels is derived from the transversalis fascia, and the lower from the iliac fascia.

265. In passing down the canal, the cord meets with the inferior fibres of the internal oblique, *after it has passed* the transversalis, and carries *some portion of* it down under the name of *cremaster muscle.*

266. The *epigastric artery* arises from the external iliac a little above Poupart's ligament; it first descends, then turns upwards and inwards, lying behind the canal, and internal to the internal ring; it then enters the sheath of the rectus, and anastomoses with the internal mammary (188).

The *spermatic cord* is composed of spermatic artery, vein, nerves, absorbents, vas deferens, and a fibrous covering, which is the remains of the peritoneal coat, carried down with the testis.

At the internal ring, the *vas deferens* turns inwards, crosses the epigastric artery, and is enclosed in the fascia transversalis.

267. *Inguinal hernia* may be *direct, oblique, scrotal*, or *congenital.*

268. *Direct* protrudes at the external ring without passing down the canal; it either passes through or pushes the conjoined tendon before it; as it emerges, the crest of the pubes is below; the pillars of the external ring surround it; the cord and epigastric artery both lie to the outside, the former being slightly in front. The coverings are *skin, superficial fascia, fascia spermatica*, a partial covering of *cremaster, conjoined tendon, fascia propria*, and *sac*, or *peritoneum*. The shape of the tumour is circular, and is directed downward.

269. *Oblique hernia* passes through the internal *ring, down* the canal, and out at the external: if *it remain* in the canal it is called bubonocele, and *if it descend* into the scrotum, scrotal hernia.

The internal ring offering the weakest point for the protrusion of hernia, we find that this species is most frequent. Its *coverings* are, *skin, superficial fascia, spermatic fascia, cremaster muscle, fascia propria*, and *sac;* the cord lies behind, and the neck of the sac is situated at the internal ring. The shape of the tumour in *oblique* is oblong, and directed inwards; in *direct*, circular, and directed downwards; the *cord*, in *direct*, lies to the outer side.

270. *Scrotal hernia* is that in which the tumour descends into the scrotum to the upper part of the testis, which it presses downwards.

271. *Congenital hernia* follows the descent of the testicle into the tunica vaginalis, and lies in this cavity in contact with the testis. *Infantile hernia* (or *encysted*), is where the protruding bowel pushes before it a sac of peritoneum, either into or close behind the tunica vaginalis.

272. When *intestine* alone protrudes, the hernia is called *Enterocele*—when *omentum, Epiplocele*—when both, *Entero Epiplocele.*

273. Oblique inguinal hernia, of long standing, and great size, may push down the epigastric artery to the inner side of the external ring, and thus obliterating the spermatic canal may be mistaken for the direct form assuming the appearance thereof, and so may mislead the surgeon.

274. *Hernia* may be *distinguished* from other tumours by its softness—by its return into the *abdomen on pressure*—by the impulse commu-

nicated to it by coughing—and by its not being attended with any derangement of the general health.

275. Violent exertion, a relaxed state of fibre, or the canal remaining open, are the causes of this protrusion.

276. It is very rarely *cured*, except in young persons, but as long as a truss, placed on the external ring in direct, and on the internal ring in oblique, keeps up the tumour, there is no danger. In some cases the radical cure should be attempted; the best results derived are from *Wood's operation.*

277. *Strangulated hernia* is known by the following symptoms—a *tumour* which cannot be returned; *vomiting*, at first of *bilious*, but afterwards of *stercoraceous* matter; *constipation; dragging sensation* at the pit of the stomach, which is the first symptom felt; *pain; tense* and *swollen state* of abdomen; a *pulse* at first full, but afterwards quick, hard, and weak; *great anxiety and restlessness; cold extremities; hiccough; cold, clammy perspirations;* indications of *mortification*, and *death*.

278. Attempts to *reduce* the strangulated gut should be made in this order, previous to operating: the *taxis* for a quarter of an hour; *warm baths*, and bleeding if the patient is robust; then the *taxis* again; *bags of ice* to the part; and in inguinal hernia, where the patient is not much debilitated, *a tobacco enema*, composed of one

drachm of tobacco to half a pint of water, may be thrown up, and be repeated in a quarter of an hour; the *taxis* should again be applied, and then, if the symptoms are urgent, and all these means have failed, the *operation* should be resorted to without delay. Chloroform is the first aid to taxis to be tried. A large dose of opium or morphia, is most useful in cases of acute strangulation, if from any reason chloroform cannot be given, or if the pain and vomiting are violent.

279. It has been proposed to inject large quantities of fluid or air into the rectum, and in some instances these modes of treatment have been said to prove successful.

280. *Tobacco enemata* prove useful only where the stricture is muscular, and as such is not the case in females, they are never admissible with them. *Cold applications* condense the gases in the tumour, and at the same time reduce inflammation.

281. If it be found impossible to reduce the tumour, no time should be lost in operating, as *mortification* rapidly comes on, and renders the operation useless.

282. In operating for hernia, the incision should be made near the seat of stricture, and need not, as formerly advised, be extensive. Divide the *skin, fat,* and *superficial fascia;* the successive parts should then be pinched up, and opened upon *a director,* to the extent of the first incision, and the sac if necessary laid open: having ascertained

where the stricture is, a probe-pointed bistoury should be guided to it, and if at the internal ring, the stricture should be divided upwards and outwards. In many cases it will not be necessary to open the sac; the stricture having been divided, the hernia is at once returned without difficulty.

After *returning* the intestine, one or two sutures and light dressing may be applied.

283. If the *omentum* is found protruding, and is diseased, it may be cut off, and its arteries tied, or if the intestine is highly mortified, an *artificial anus* must be formed.

284. The stricture may be—1st, at the *external ring*, in which case it is formed by the pillars; 2nd, *in the canal*, where some degree of thickening of the fibres of the internal oblique is the cause; 3rd, at the *internal ring*, where the inferior margin of the transversalis muscle constricts it.

285. The *peritoneal sac* may be distinguished from the *covering of the intestine* by the arborescent appearance of its vessels; by the external surface being rough and adherent; by its being of a lighter colour, and by the slipping away of the intestine on rubbing it between the fingers. On the intestine the peritoneum is smooth and polished, and the vessels are circular.

286. The *operation* for *direct hernia* resembles that for oblique, but the incision is to be made more vertical, and the stricture to be divided upwards and inwards, or directly upwards. The *stricture* is situated *above* and *behind* the external

ring, where the hernia passes through the conjoined tendon.

287. In performing the taxis, the limbs should be kept as close as possible, and the parts relaxed by bending the thighs; after the operation, the patient should not be allowed to rise till a truss has been applied.

288. There may be no sac if the hernia follows a wound, or if the cæcum protrudes (225), or when adhesion has taken place between the two layers of peritoneum.

289. It is not every hernia which cannot be returned that is strangulated, as adhesions sometimes take place whilst the parts are down: it is then called *incarcerated.*

FEMORAL HERNIA.

290. The parts which pass *beneath Poupart's ligament,* through the *crural arch,* are—iliacus internus; anterior crural nerve; psoas magnus; femoral artery, vein, with their sheath and the *deep crural arch* connecting this sheath with Poupart's ligament and absorbents.

Internal to the femoral vein and in the same sheath is a *space* (the *crural canal*) in which lies an absorbent gland, and internal to this, *Gimbernat's ligament.* This canal is blocked in above by the *septum crurale.*

291. *The saphenic opening* is a space, formed *in the fascia* lata, *just below* Poupart's ligament.

The iliac portion of the fascia, or that attached to Poupart's ligament, forms an arched border which looks downwards, and constitutes the *falciform edge;* the pubic portion, or that which is attached along the ramus of the pubes, forms another arched border, which looks upwards, and is called the *semilunar margin;* the space between these two openings is called the saphenic, and gives entrance to the saphena vein, and exit to the superficial pubic, superficial epigastric, and circumflex branches of the femoral artery.

In this space there is no fascia lata in front of the femoral vessels, but the pubic portion is found to be continued up behind them, and to be attached to the linea ilio-pectinea.

292. *Femoral hernia* passes down, internal to the vein, and external to Gimbernat's ligament, pushing the gland before it, and carrying the fascia propria (a layer of dense areolar tissue derived from the sheath of the vessels) with it; having reached the falciform, or saphenic opening, the reflected portion of the fascia lata, behind the vessels, prevents any further descent, and therefore, if the hernia continues to increase, the tumour proceeds upwards, *over Poupart's ligament.*

The *coverings* of this hernia are, the skin; superficial fascia; fascia propria; and sac; as it lies close to the femoral vein, having passed between it and the fascia propria, it is said to be *in the sheath* of the vessels.

The seat of stricture may be either at the falciform edge of the fascia lata, at Poupart's ligament, or in the neck of the sac.

This *kind of hernia* rarely happens in *males*, as the greater breadth of *the pelvis in females* offers a larger space for its passage; on the contrary, *inguinal hernia* is more frequent in *males*, the canal being kept open by the cord lying in it.

In addition to the other symptoms of strangulated hernia, there is in *femoral*, sense of weight, numbness and œdema of the leg from pressure on the vessels.

293. *In operating*, an *incision* resembling an inverted ⊥ is to be made over the tumour, and the parts to be divided on a director; having ascertained the stricture, it is to be divided, if at the falciform edge, *upwards* and *outwards ;* if at the neck of the sac, *upwards* and *inwards ;* or if at Poupart's ligament, *upwards*. Occasionally some fibres of Gimbernat's ligament must be divided.

Some surgeons recommend the cut to be made backwards, stating that the division of the ligamentous fibres, attached to the linea ilio-pectinea, will answer the purpose.

294. In *applying the taxis*, the legs should be flexed to relax the fascia lata; the tumour must first be directed downwards, then backwards, and finally pressed upwards; and the surgeon must remember, that the stricture is never muscular. Should the taxis, warm bath, and bleeding fail, the operation should be resorted to even more *speedily than* in inguinal hernia.

295. Cessation of pain, accumulation of gas, sinking of the pulse, hiccough, and cold perspiration, indicate the coming on of *mortification*; and the intestine is known to be in that state, when portions of it are of *an ashy green colour, of soft consistence, and of fœtid smell.*

If *inflammatory symptoms* come on after the operation, they must be subdued by bleeding and leeching; purgatives must not be administered too soon, lest the bowels should not have recovered their tone. Fever and sickness must be treated by effervescing medicines, or calomel and opium.

296. *Congenital hernia* does not generally occur till after birth, as there is no compression of the viscera in the fœtal state; it more frequently contains intestine than omentum, the latter being very short in the child; and when the bowel is down in this hernia, the hernia descends below the testis, which is found at the back and upper part of the tumour.

The treatment is the same as in other herniæ, and by the constant wearing of a truss, a radical cure is often made: should an operation become requisite, hernia will be found in the tunica vaginalis; the seat of the stricture is generally at the external ring.

297. *Exomphalos* is the protrusion of omentum or intestine at the *navel;* it has a circular neck, and around the tumour may be felt the margin of the umbilical ring. Its coverings are a peritoneal

sac and cellular tissue, but frequently the investments are very thin.

It is more frequent in females than males, and generally contains both intestine and omentum.

298. In hernia beneath the navel, the *cicatrix of the umbilical ring* may be felt, but cannot in umbilical hernia itself.

Exomphalos may generally be reduced, and in young persons frequently cured, by the application of a truss.

299. *The other kinds of herniæ* are, ventral, through any part of the abdominal parietes; cystocele, or hernia of the bladder, into the scrotum; hernia, through the thyroid foramen; through the sciatic notch into the vagina, or perineum; through the diaphragm.

Diagnosis

300. Between *inguinal* and *femoral hernia*—is thus: in *inguinal*, the tumour is situated above, in *femoral*, *below*, Poupart's ligament; in *inguinal*, it is *at* the external ring, in *femoral*, external to it; in *femoral*, the tumour may be traced downwards below Poupart's ligament, even if large enough to be found above.

301. *Oblique* is distinguished from *direct*, by the *oval shape* of the former, the *circular* of the latter; by the *former* being directed *downwards and inwards*, the latter *directly downwards*; by

the spermatic cord being behind in the former, more in front in the latter.

302. *Inguinal hernia* is distinguished from hydrocele thus: the tumour proceeds from *above downwards* in *hernia;* in *hydrocele*, from *below upwards; hernia* is opaque, *hydrocele* transparent; *hernia* disappears on lying down; *hydrocele* does not; *hernia* does not fluctuate; *hydrocele* does; *hernia* dilates on coughing, *hydrocele* does not; in *hernia* the testicles are *below* and *behind* (this however may vary); in *hydrocele above* and *behind.*

303. *Psoas abscess* is distinguished from inguinal hernia by its being situated beneath Poupart's ligament, by the constitutional symptoms, and by its returning in the erect posture although pressure is made on the femoral ring.

304. *Bubo* is known by the *hardness* of the tumour, by its being *external* to the ring, by its not receiving any impulse on coughing, and by the constitutional symptoms and history.

305. *Hydrocele of the cord* is known by its *fluctuation* and *transparency.*

306. *Varicocele,* by its *soft consistence;* and by its *colour.*

307. *Hydatids* by the *fluctuation,* and by not disappearing *on pressure.*

CHAPTER XII.

ON THE ANATOMY AND SURGERY OF THE PELVIS.

308. THE pelvis, situated at the lower extremity of the spinal column, differs greatly from the other *cavities*, since by the strength of its walls great protection is afforded to the contents, fixed attachment is given to the muscles moving the abdomen and lower extremity, and free passage is allowed, or great dilatation admitted of, by its upper and lower apertures.

Its *boundaries* are, *posteriorly* and *below*, the sacrum and coccyx; *laterally* and *anteriorly*, the ossa innominata. The *upper aperture*, which separates the true from the false pelvis, is formed anteriorly and laterally by the brim, posteriorly by the promontory of the sacrum; it looks upwards, forwards, and towards the umbilicus: its *transverse diameter* in the male is four inches six lines; in the female, five inches six lines; its *oblique diameter*, in the male, four inches five lines; in the female, four inches seven lines; its antero-posterior, in the male, four inches; in the female, four inches four lines. The *lower aperture*, bounded in *front* by the angle of pubes, *laterally* by tuberosities of ischia, *posteriorly* by os coccyx, and great sciatic ligaments, looks downwards and forwards. The *transverse* diameter of this opening is, in the male, three inches; in the female, four inches five lines; the *antero-posterior*, three inches three lines, in male; four inches four lines in female.

The bones are united by *synchondrosis*, a species of articulation which admits of but little motion, but the union between the *sacrum* and *coccyx* is an arthrodia, and allows of greater freedom, especially in youth.

309. The *contents* of the pelvis are—the bladder, with its ligaments, the ureters, vesiculæ seminales, vasa deferentia, internal iliac vessels, sacral nerves and rectum; *in the female*, the bladder, rectum, vagina, uterus, ligaments, ovaries, &c.

310. The *bladder* is a *musculo-membranous viscus*, placed between the symphysis pubis and the rectum, in the male; between the symphysis pubis and the uterus, in the female.

It is of an *oval* form, with its apex looking upwards and forwards towards the umbilicus; its base or fundus towards the rectum. It has *three coats* —1st, a *peritoneal*, which is only partial (225), and leaves the anterior and inferior portion uncovered. 2nd, a *muscular*, in which the fibres are disposed in different directions, but are principally longitudinal and circular; *the first* of these are usually called *detrusores urinæ; the latter*, which are internal, form a sphincter at the neck; some few fibres are also seen passing from the neck to the orifice of the ureters. 3rd, a *mucous*, which forms numerous *rugæ*, or folds, for the purpose of allowing dilatation; these rugæ are not seen at the trigone. At the *fundus*, beneath the peritoneum, is the triangular space, the apex of which is formed by the prostate gland; the sides by the vesiculæ seminales and the vasa deferentia—the latter being internal; and the base by the peritoneum, reflected from the rectum on to the bladder. This nearly corresponds to a similar triangular space in the interior of the bladder, the *trigone vesicale;* at the two posterior angles of this space the *ureters* open, and at the anterior is the orifice of the urethra; this portion is the most sensitive part, and upon it rests stone in the bladder.

311. The *true ligaments* formed by the pelvic fascia are *four*—viz., two anterior, from the neck to the back of the pubes, and a lateral one on each side, in which lies the vas deferens: *five false*—viz., two posterior, in which run the ureters, one on each side, and one anterior.

312. Surrounding the orifice of the urethra is the *prostate gland,* about the size of a *chestnut,* and consisting of *three lobes*—namely, two lateral, and a middle or posterior, which is not larger than a pea when in a healthy state, but which becomes nearly as large as a small orange sometimes in prostatic disease.

313. The *bladder,* as it lies in situ, is placed upon the levator ani muscle, and upon the rectum, and, when expanded, rises into the hypogastric region (224). In the *fœtus,* where the pelvis is very shallow, it lies higher up; and in the female,

where the pelvis is much broader, it is also broader and larger, and admits of more distension.

314. The *urethra* extends forward from the orifice of the bladder to the meatus, and is lined by the same mucous membrane; it is divided into the *prostatic*, rather more than an inch; the *membranous*, rather less than an inch; and the *spongy*, about seven inches in length. The *prostatic portion* passes through the prostate gland; on its inferior surface is seen a small mucous eminence, called *verumontanum*, on the sides of which are the sinus pocularis for the entrance of the ejaculatory duct, and the sinus prostaticus, for the several minute prostatic ducts. The *membranous portion*, which extends from the prostate to the bulb, is enveloped in the deep perineal fascia, and lies upon the levator ani and Wilson's muscle; this is the narrowest portion, and has beneath it Cowper's glands and the perineum.

The *spongy portion* extends from the bulb, immediately anterior to the passage of the urethra through the triangular or Camper's ligament, to the meatus; it is surrounded by the spongy structure, and expands just before its termination, forming the fossa navicularis, and just anterior to the triangular ligament, forming the bulb. Several minute mucous follicles are seen along this portion, called lacunæ, and near the bulb, one larger, called *lacuna major*.

The *corpora cavernosa* commence in the crura penis, at the rami ischii, near the tuberosities, and

extend forward to the corona glandis; the *spon*
structure, in which the urethra lies, is placed b
neath the membranous; it extends from the bu
to the anterior part of penis, where it expands in
the glans.

PERINEUM.

315. The *superficial fascia* is closely attach
to the rami of the ischia and pubes; above, it
continuous with the superficial fascia of the scrotu
and abdomen, while posteriorly, it unites with t
deep fascia.

The superficial perineal, and the transversa
perinei arteries, lie *beneath* it; extending outwar
from the central point to the tuberosity, are t
transversales muscles; and extending forwar
upon the bulb, are the acceleratores urinæ muscle
whilst posterior to this point is seen the sphinc
ani; laterally upon the crura penis are plac
the erectores penis, and in the space between t
anus and ischiatic ligaments, on each side,
the levatores ani, separated from the skin by mu
fat.

316. The *deep perineal fascia* lies nearer
the urethra than these muscles, and is formed
the posterior layer of Camper's ligament, extendi
backwards, along the membranous portion, wh
it closely invests, to the prostate gland and mar
of anus, where it becomes thin and indistin
laterally, this fascia is attached to the osse
boundaries of the perineum, and is connected

the fascia which passes over the obturator foramen.

317. *Wilson's muscle,* or compressor urethræ, seems to be the anterior fibres of the levator ani, separated from it by a few veins and cellular tissue.

318. The *levator ani* arises from the posterior aspect of symphysis pubis, across the obturator foramen, in a line extending to the spine of the ischium, and from that process, and from between the splitting of the pelvic fascia; its fibres pass downwards, are inserted in the raphé and coccyx, and are continuous with the external sphincter ani. The bladder, prostate gland, membranous part of the urethra, and the folds of pelvic fascia passing on to the bladder, lie *above* this muscle; the deep perineal fascia, another layer of pelvic fascia lying upon the obturator muscle, and the perineum, lie *below;* its use is to prevent prolapse of the anus.

319. The *iliac arteries* extend from the bifurcation of the aorta to the sacro-iliac synchondrosis; the left is most vertical in its direction; the right has, *in front,* the appendix vermiformis and cæcum (224); *behind,* the right and left common iliac veins, *to its outer side* the psoas, and at the bifurcation into the two iliacs, the ureter crosses; the left has the sigmoid flexure of colon in *front,* but has no veins *behind;* it is in other respects similarly placed to the other.

The *external iliac* extends from the bifurcation to Poupart's ligament, and lies on the inner border of the psoas muscle; to its inner side lies the vein, to its outer the anterior crural nerve, and in front the iliac fascia.

Its branches are, the internal epigastric and the circumflexa ilii.

320. The *internal iliac* divides into *external* and *internal branches*. The *external* ones, or those which supply the walls of the pelvis, are, the gluteal, the sciatic, ilio-lumbar, lateral sacral, obturator, and pudic. The *internal* are, middle hæmorrhoidal, uterine, vaginal, vesical, and hypogastric.

The obturator gives off a branch to the hip-joint. The pudic passes out at the great ischiatic notch, enters the pelvis again at the lesser, runs along the inner side of the tuberosity, and arriving in the perineal space, divides into its branches; these are, inferior hæmorrhoidal, transversalis perinei, superficial perineal, arteria corporis bulbosi urethræ, arteria cavernosi penis, and arteria dorsalis penis.

321. The *great sciatic notch* is a space which is bounded *below* by the spine of the ischium; *internally*, by the lesser sciatic ligament; and *externally*, by the posterior margin of ilium; through it pass the gluteal artery, vein, and nerve, the pyriformis muscle, the sciatic and pudic arteries, and the great sciatic nerve.

The *lesser sciatic notch* is the space between the two sciatic ligaments; *through* it pass the *obturator internus* muscle, and the pudic artery.

322. The *urine* reddens litmus paper; decomposes very quickly, by absorbing hydrogen, which, with its nitrogen, forms ammonia; when this is the case it has no longer an acid reaction, but commences depositing the earthy phosphates.

Its *chemical composition* is—urea, uric acid, free lactic acid, and lactate of ammonia, salts of potash and soda, phosphates of ammonia, soda, and lime: according to Dr. Prout, there are no free acids, but the acidity depends upon the super salts.

323. The *urinary deposits* are—*lithic acid*, in the form of red crystalline sediment; *triple phosphates*, a white crystalline sediment; *lithate* and *phosphate* of *ammonia*, pink; *lithate* of *ammonia* and *soda*, brown; *lithate* of *soda*, reddish brown; red gravel, or lithic acid, occurs in gouty, luxurious, and indolent persons; white gravel in weakly habits, or those who have taken alkaline remedies too long. Urea is composed of cyanate of ammonia, and as cyanic acid is formed by the same elementary bodies as carbonate of ammonia, the large quantity of ammonia found in urine is accounted for easily.

324. The *different calculi* are—1st, *Lithic* or *uric acid;* 2nd, *phosphate of lime* or bone earth calculus; 3rd, the *ammoniaco-magnesian phosphate*, or *triple* phosphate; 4th, the *fusible*, or a mixture of the 2nd and 3rd; 5th, the *oxalate of lime* or *mulberry* calculus; 6th, the *cystic oxide;* 7th, the *xanthic oxide.*

1st, The *uric acid* is of a hard brown or fawn colour, inodorous, and smooth; it is soluble in potash, and in nitric acid with effervescence, and disappears under the blowpipe.

2nd, The *bone earth* is of a pale brown colour, quite smooth, but arranged in laminæ; it is insoluble in potash, but soluble in nitric or hydrochloric acid.

Phosphate of ammonia and *magnesia* rarely exist *alone;* these calculi are white and less compact than others; they are not soluble in potash, but give off ammonia; they are soluble in acetic acid.

The *fusible calculus* is of a white colour, ragged and uneven.

The *cystic oxide* is not laminated, but of a greenish white colour, and less compact than triple phosphate.

Xanthic oxide is of a reddish-yellow colour.

The *mulberry calculus,* of a dark brown tuberculated appearance, is soluble in nitric or hydrochloric acid, leaves lime under the blowpipe, which stains turmeric paper brown. The disposition to form this calculus is rare, but is known by the urine being high coloured and acid, and never depositing gravel; it occurs in persons of the same diathesis as lithic acid does. The average quantity of urine voided daily is from thirty to forty ounces; its specific gravity is 1·02246.

325. The symptoms of *renal calculi,* which are *generally lithic* acid, are, spasmodic pain and

tenderness in the loins, increased by excessive diet or exercise, bloody urine, pain and retraction of the testicle, red gravel deposit in the urine, and irritable bladder. The nature of the deposit must be ascertained, and remedies likely to overcome it given.

Urea being the distinguishing principle of urine, and containing so much nitrogen, it is said that nitrogen is the element eliminated in the kidney, as hydrogen is in the liver, and carbon in the lungs.

326. *Inflammation of the kidney* is known by severe pain and tenderness in the loins, increased on pressure, vomiting, scanty and high-coloured urine, which may be totally suppressed, tinged with blood, or attended with a frequent desire to pass; *albumen* is also sometimes present, but this seems indicative of granular degeneration; the pulse is full, hard, and frequent, and there is pyrexia.

327. *Stone in the bladder* is most frequent in childhood and old age, but may occur at any period. The symptoms are, frequent desire to void urine, but sudden stoppage in the flow of it; and by the dribbling of a few drops directly the trousers are buttoned up; pain and itching at the extremity of the penis; weight in the perineum, and increase of these symptoms when the bladder is empty; bloody urine after taking exercise, urine loaded with mucus and pus; irritation of the penis, causing a child constantly to pull the

prepuce, which becomes elongated, the sudden stoppage being sometimes overcome by change of posture.

The only unequivocal means of detecting stone are, either the *introduction of the finger* in the anus, or of a *sound* along the urethra.

The *state of the urine* will indicate the nature of the calculus; an acid or alkaline quality denoting lithic acid or triple phosphate, greatly aggravates the symptoms; so likewise does any inflammation of the mucous membrane. Small stones are usually attended with more pain than large ones, where there is an inflamed state of this membrane.

Prostatic disease frequently gives *rise* to calculi, as the urine remains in the bladder, and allows of time for deposits to take place; the kind of deposit in such cases is usually *phosphate of lime.*

The *size of the calculus* is judged of by the time it has existed; by measurement, with the finger introduced in the anus, and a sound up the urethra at the same time; by the composition, as the lithic acid and mulberry are smaller than the phosphatic; by observing the force required to dislodge it.

328. Frequently calculi form *in the kidney,* and whilst small in size pass down the ureter and form nuclei; the *symptoms of their passing* are, extreme pain in the kidney, extending down the *thigh, and coming* on at intervals; pain, retrac-

tion, and tenderness in the testicle; vomiting, pulse unaltered in the first instance, but increased when the symptoms have continued some time; and, towards the end, symptoms of collapse.

Large doses of opium, warm baths, emollient enemata, copious draughts of diluents, and occasionally an active purgative, constitute the treatment.

329. There are four ways of removing calculi; 1st, by *dilatation of the urethra;* 2nd, by *dissolving them with injections;* 3rd, by *lithotrity;* 4th, by *lithotomy.*

The first may be done by introducing large-sized bougies; by causing the patient to drink plentifully, and pass his urine whilst lying on his face or by the urethral forceps.

They may be dissolved when they are small and recent only; solutions of nitric acid act upon the phosphatic, and relieve the irritable state of the mucous membrane, which is attended with viscid mucous secretion; liquor potassæ is serviceable where lithic acid forms the nucleus. These injections must be used through gold or platina catheters; the strength of the first should be about ♏ij to ℥j of water; of the second, ♏iij to ℥j of water.

330. *Lithotrity* is only applicable where the bladder is quite healthy and the urethra large and not irritable, where the calculus is small, or where there are several, and where the operator is particularly dexterous.

331. *Lithotomy* should not be undertaken where

there is *disease* of the mucous coat to any extent, or where there is *organic disease* of the kidney, indicated by albuminous urine; by loss of strength and emaciation; and by rigors and weakness of the loins.

Calculi in females generally pass away of their own accord, or they may be removed by dilating the passage; but there is considerable danger of incontinence of urine remaining if the dilatation is carried to too great an extent, or if lithotomy be performed.

332. In performing *the operation of lithotomy* the first incision should be made from an inch before the anus, or immediately behind the scrotum, to midway between it and the tuberosity of ischium, dividing skin and superficial *fascia;* the second should divide the fibres of the accelerator urinæ, transversalis perinei artery, the transversus perinei muscle, part of the levator ani, and the deep perineal fascia; having then felt the groove in the staff with the left forefinger, and having depressed the handle, a lithotomy knife should divide the membranous part of the urethra and the left lobe of the prostate.

The first incision enters a triangular space, formed by the bulb and accelerator urinæ on the inner side; by the crus penis and erector penis on its outer; and by the transversus perinæi behind. The parts which are to be avoided are—the artery of the bulb, the internal pudic itself, the rectum, and the vesiculæ seminales.

333. The bladder should be *full* at the time of operating, and the patient should be *sounded previously*, as it is not prudent to proceed unless the stone is felt *immediately* before; the rectum should be empty.

Whatever instrument is used, its edge should be directed downwards and outwards, to avoid the rectum: there is less danger of wounding the pudic artery, as it is protected by the tuberosity and a portion of the great sciatic ligament.

Care must be taken not to cut *beyond* the prostate gland, as *infiltration* of urine might result; but if the stone is very large, an *incision of the other lobe* of the prostate may be made.

The stone is to be seized in the *short diameter*, and if any fragments are left, the bladder must be washed out with warm water.

334. The *objections* to the gorget are—1st, that the incision must be of a certain size; 2nd, that the great force required to push it through the prostate and perineum may cause it to transfix the rectum through the posterior wall of the bladder; 3rd, the laceration which it may cause, and the separation even of the prostate from the bladder. If the pudic artery be injured, the wound should be *distended with sponge* as soon as the stone has been extracted, or a *ligature* may be applied to it. The *principal danger* after the operation of lithotomy is *peritoneal inflammation*.

335. In enlargement of the prostate, the symp-

toms of stone are less severe, because it cannot fall against the neck of the bladder.

336. When the stone is not of large size, it may become impacted in the urethra, and may be removed by cutting down upon it, through the perineum.

337. The *high operation* consists in cutting into the bladder above the pubes, but below the peritoneum; where the prostate is much diseased, or the inferior outlet of the pelvis contracted, this operation may be advisable, but the danger of escape of urine into the cellular tissue above the pubes, by displacement of the canula, and the sinking of the empty bladder, is so great, that it is rarely performed.

The *recto-vesical operation* may be performed when the stone protrudes much in that direction, but the passage of the urine over the rectum is apt to produce inflammation, ulceration, and sloughing; this and the manifest impossibility of performing it where the prostate is enlarged, have rendered surgeons averse to it.

338. *Enlargement of the prostate* may arise from common inflammation, whether resulting from calculi, from gleet, from formation of abscesses, from strictures, or from chronic induration, which is usually of a scrofulous nature (312).

It occurs usually towards old age, and is slow in progress.

Its *symptoms* are, a frequent desire to void the *urine; inability* to pass much, or to empty the bladder; straining, and at times retention or dribbling of urine; discharge of viscid, ropy mucus, particularly on passing fæces; irritation about the rectum and perineum; flattened fæces; pain and weakness felt down one leg, generally the left; these go on for a considerable time without injuring the general health much, but at length the functions of digestion are affected, there is flatulence, tenesmus, discharges of blood, and disease of the coats of the bladder, ureters, and kidney, emaciation, anxiety, and loss of rest.

Many of the symptoms may be mitigated, but there is no cure for this complaint; local bleedings, narcotics, warm and cold bathings, introduction of the catheter to remove the water, opiate enemata, setons, issues, preparations of mercury and iodine, both internally given and externally administered, and attention to the diet and bowels, are the remedies most likely to prove beneficial.

339. There is some danger in suddenly emptying the bladder, where the kidney is diseased, unless the patient's strength is supported with tonics and cordials.

The catheter is to be avoided where the inflammation is active, but in the chronic enlargement it is essential. A full-sized and long catheter should be used.

340. *Paralysis* of the bladder follows injury of the spine, fever, any severe accident, or long distension; it causes the bladder sometimes to become enormously distended; at which time, by compress-

ing the abdominal muscles, a considerable quantity may be passed. Hysterical paralysis is produced from a different cause, and the usual remedies for hysteria generally cure it without the catheter.

CHAPTER XIII.

ON THE URINARY AND GENERATIVE ORGANS.

341. *Strictures of the urethra* may be—1st, *inflammatory;* 2nd, *spasmodic;* or 3rd, *permanent* or organic.

1st, *Inflammatory* follows or accompanies gonorrhœa, and is occasioned by the inflammatory action of the mucous membrane becoming excessive; it occurs *in the spongy portion* of the urethra, and is attended with frequent *chordee,* intense pain in voiding urine, fever, and discharge.

Depletion, fomentations, lotions, purgatives, antimonial medicines, calomel, opium, and low diet, are indicated; if these remedies do not relieve, effusion of lymph takes place, and a permanent stricture is established.

2nd, *Spasmodic* in most cases, is situated in the membranous portion, which is the part alone surrounded by muscular fibres.

The *symptoms* are, frequent desire to void *urine; partial* or total inability to do so; dribbling of a few drops afterwards; division of the stream; pain in the perineum and bladder; which last may be felt distended over the hypogastric region.

The attack is generally sudden, and comes on after excess in diet or drinking acid wines, from sudden exposure to cold after coming out of a warm room, from tendency to spasmodic action in the system, or from neglecting to evacuate the bladder.

Treatment, is to pass a medium-sized gum-elastic or silver catheter if possible, to put the patient into a warm bath, to give an opiate enema, to bleed from the arm, to give antimony till nausea is produced, and to apply leeches to the perineum. Should the case be trivial, the *catheter* can generally be passed after a warm bath; and all that is then necessary is to keep all stimulating fluids away, to administer oleaginous or some other unirritating purgative, and to keep up the treatment for a short time, lest the spasm should return.

If the stricture is very complete, and cannot be overcome by these remedies, the urethra after dilating, behind the seat of the disease, may burst and cause extravasation of urine into the perineum; the bladder never bursts except from violence; to prevent extravasation, the bladder must be punctured or the urethra divided in perineo (perineal-section).

3rd, *Permanent*, results from either of the other kinds, or may be produced by enlargement of the *lacuna major;* it may be simple, or extend for some distance along the canal; and it may follow diseased prostate, or may be caused by injections inducing inflammation and thickening of the membrane.

The *symptoms* of this form come on gradually; the stream of urine continues to contract, becomes forked, and at length can only be passed in drops; there is great irritability of the bladder and mucous discharge.

342. The *modes of curing strictures* are—1st, *by dilatation*; 2nd, *by caustic*; 3rd, *by division*; 4th, *by causing sloughing*; 5th, *by perineal section.*

1st, *Dilatation of the passage* is the most usual means, and is sufficient where even the smallest-sized bougie can be passed; sometimes, however, a large one will pass better than a small one, as the latter catches in one of the lacunæ, or in a fold of membrane; sickness and fainting frequently follow its first introduction, but as the membrane becomes less irritable, this soon goes off. Care should be taken to warm a metal catheter by passing it up the arm, under the sleeve, until it acquires the heat of the body before using it. Dilatation by expanding instruments is resorted to by some surgeons, such as Holt's dilator.

Ordinary *gum-elastic bougies* cause less irritation than others, and can often be borne better; but in old cases where the stricture is confirmed, metallic ones, slightly bent, are the best.

2nd, *Caustic* is applied to the stricture, by passing up to the part a bougie, armed at the extremity with nitrate of silver. The injudicious *use of them is* highly dangerous, as they *increase or even produce* strictures, cause hæmorrhage, false *passage*, abscess, and fever.

3rd, *Cutting* is performed by passing a metallic catheter, down which a cutting instrument is pushed through the stricture; by passing an instrument, from which a cutting blade flies out on touching a spring, or by *dividing* the stricture through the *perineum.*

4th, The *sloughing plan* consists in keeping a gum-elastic catheter in the urethra till *suppuration and sloughing* have destroyed the stricture; it is adapted to cases where there are false passages; fistulæ, where the frequent introduction of bougies causes irritation; or in cases where the obstruction is of a gristly nature.

5th, *Perineal section,* most useful in cases of impervious complicated stricture, where the stricture is very irritable, and resists the common treatment of dilatation.

343. The *consequences* of stricture are—*fistulæ in perinæo; disease of the prostate; thickening of the walls of the bladder; disease of the kidney; dilatation and rupture of the urethra* behind the stricture; *dilatation and rupture of the bladder, and extravasation of urine.*

344. *Extravasation* is known by œdematous swelling of the perineum, extending over the cellular tissue on the scrotum and the abdomen, but not on that down the thighs (317). The infiltrated parts rapidly slough, typhoid symptoms come on, and the patient sinks rapidly and dies. *Treatment* —extensive scarifications; the urethra should be laid open at the seat of the stricture, and a *catheter* passed into the bladder to keep it empty.

345. *Fistulæ in perinæo* frequently follow strictures; the urethra becomes dilated posteriorly to the obstruction; a hard tumour is felt in the perineum, which approaches the surface, becomes soft and fluctuating, and bursts: *matter* is first discharged from the *abscess*, then *urine*.

346. *Abscess* in the perineum should be opened early, as the passage of the urine through the wound is apt to cause sloughing. These fistulous openings cannot *heal* till the *stricture*, which is the *cause* of them, is cured. Openings should be made in the mesial line.

347. Retention of urine must be distinguished from suppression, in which there is *no urine secreted;* in *inflammatory disease* of the kidney there is little urine formed; but where there is retention, *the distended bladder may be felt.*

348. *Puncture of the bladder* may be performed—1st, *above* the pubes; 2nd, *through the rectum;* 3rd, *behind* the stricture, in the urethra; or, 4th, *through the perineum*, as in lithotomy.

Where symptoms allow of it, that through the *urethra* should be preferred, as it exposes the seat of disease; a grooved sound should be passed down to the stricture, which should be laid open, and the sound then passed into the bladder; this is then withdrawn and a catheter passed.

Where the *prostate* is much *diseased*, the *bladder* may be punctured above the *pubes;* but the *objections to* this operation are great (312).

The puncture *through the rectum* is preferable to the last, but a *communication* between the *bladder* and *rectum* is to be avoided if possible.

349. *Incontinence of urine* depends, 1st, upon *paralysis of the sphincter vesicæ;* 2nd, upon *spasmodic action or irritation* of the bladder; 3rd, upon *imperfect action* of the sphincter during sleep; 4th, upon *communications* existing between the bladder and vagina.

The *state of system* which leads to these kinds of incontinence must be ascertained, and treated accordingly.

350. *Gonorrhœa,* or clap, is an inflammation of the mucous membrane of the urethra, which may arise from contact with infectious or purulent matter, or from any irritation acting on the passage; it may be either *acute* or *chronic.*

The symptoms of the acute are, a discharge from the urethra, accompanied with scalding sensation when the urine is voided; constant desire and frequent inability to pass it; chordee; redness of the glans, and a greater or less degree of fever.

If the inflammation run high, there may be,—1st, *phymosis,* or inability to draw the prepuce *back* over the glans; 2nd, *paraphymosis,* or inability to bring the prepuce *forward* over the glans; 3rd, *inflammation of the testicle;* 4th, *sympathetic bubo;* 5th, *inflammation of the bladder.* The *treatment* for this complaint is to be strictly antiphlogistic; and remedies which act on the mucous membranes, such as copaiba and cubebs, are administered with success: by some surgeons *early injections* have been advised, but generally this plan is not considered judicious.

351. *Gleet* is the *chronic* state of this inflammation, and depends—1st, *upon the altered secretion* which the mucous membrane gives out after all inflammation has subsided ; 2nd, *upon stricture ;* or, 3rd, *upon debility*. *Injections* of zinc, bichloride of mercury, lead, or nitrate of silver ; cantharides, preparations of iron, blisters, sea-bathing, tonics, and the passage of bougies smeared with mercurial ointment, or alone, are the remedies most likely to prove beneficial.

352. The *testis* is situated in the fœtus immediately below the kidney ; a fibro-muscular cord, called *gubernaculum testis*, passes down the inguinal canal, from the testicle to the pubes and cellular tissue of scrotum, which shortens as the testicle descends, and finally disappears.

As it passes down, the testis carries with it the peritoneum, and about the *seventh month* it arrives at the spermatic canal.

When in the scrotum it is enveloped by two layers of this membrane; the *tunica vaginalis testis*, that lining the gland, the *tunica vaginalis scroti*, the layer reflected on the scrotum (*tunica vaginalis reflexa*). At first the cavities of the tunica vaginalis and abdomen communicate through the inguinal canal, but they are speedily separated by *an effusion of* lymph taking place and causing the *adhesion of* the membranes.

353. The coverings of the testicle are—skin, dartos, spermatic fascia, cremaster muscle, fascia propria, tunica vaginalis, reflexa, tunica vaginalis testis, tunica albuginea, tunica vasculosa, and true glandular structure.

The *testicles* are *oval* in form, but compressed laterally: they are about one inch and a half in length, and are suspended in the scrotum with their *long diameter* directed from above, *downwards* and *backwards;* at the posterior part is situated the *epididymis*, and internal to that the cord, between which two on the outer side dips down a fold of tunica vaginalis.

354. The left hangs lower than the right; they have three proper tunics, which are—1st, *the tunica vaginalis testis;* 2nd, *tunica albuginea*, a dense, fibrous, unyielding membrane, similar in structure to the dura mater, which after covering the testicle, is reflected from its posterior border into its interior; 3rd, *tunica vasculosa*, formed by ramifications of the spermatic vessels, lines the tunica albuginea, and passes into each of the lobules.

The *corpus Highmorianum*, or *mediastinum*, is formed by the splitting of the *tunica albuginea* at the posterior part of testicle into two layers, one of which passes along the vas deferens, the other, which is the corpus, passes down the testicle, and forms the coverings of the lobules.

355. The *tubuli seminiferi*, which are contained within the lobules, are about 300 in number, and

each of them about sixteen feet in length. They are lined by mucous membrane, and commence at the extremity of the lobules near to the circumference of the testicle; after taking a very convoluted course they pass into the corpus Highmorianum by straight tubes, called *vasa recta.* The meeting of these constitutes the *rete testis;* at the back of the testis, from twelve to fifteen vessels, called vasa efferentia pass out, which open separately into a tube called *epididymis;* their convolutions assume a conical shape, and are called *coni vasculosi.*

356. The *epididymis* (ἐπὶ upon, δίδυμος testis) is placed along the back of the testicle, and is formed by frequent convolutions of the vas deferens, into it the coni vasculosi pour the semen; its upper extremity is called *globus major;* its inferior, *globus minor,* or *cauda.*

357. The *vas deferens* is a continuation of the preceding tube; it commences at the lower part of the testicle, and extends to the prostatic portion of the urethra; ascending behind the testicle, it comes into contact with the spermatic vessels (266), and after passing through the canal, and winding round the epigastric artery, crosses over the brim of the pelvis to the inner side of the *vesiculæ seminales,* joins them, and forms the ejaculatory duct, which terminates in the sinus pocularis (314). It is distinguished from the spermatic artery and vein by its hard, cord-like feel, by its small calibre, and by its lying behind them.

358. The *blood-vessels* and nerves of the testicle are—the *spermatic*, from the abdominal aorta (247), the *deferential*, from the internal iliac which ramifies upon and accompanies the vas deferens to the testis, where it communicates with the spermatic; the *spermatic veins*, which commence by radicles from the epididymis and testicle, form a plexus on the cord called *corpus pampiniforme*, and passing up by the side of the artery, terminate, the *right* in the *vena cava*, the *left* in the *left renal* vein. The nerves are derived from the renal plexus of the lesser splanchnic: upon the cord, and principally supplying the cremaster muscle, is the *genital branch of genito-crural*, a branch of the second and third lumbar, which occasions the pain felt in the loins, when there is disease of the testis; the supply from the renal plexus also accounts for the sympathy between the testis and kidney, and that of the stomach with both.

359. The *vesiculæ seminales*, situated at the base of the bladder and along the sides of the trigone vesicle, are tubes lined with mucous membrane, about two inches and a half in length, and about three in breadth; they are much convoluted, and terminate anteriorly, each in a small duct, which, uniting with that of the vas deferens (314, 358), form *the ejaculatory duct*, about three-quarters of an inch in length.

These organs have been considered reservoirs for the semen, but are most probably secreting surfaces, the fluid of which mingles with the semen.

360. The delicate organization of the testicle accounts for its tendency to congestion, and for the great difficulty which is found in obtaining resolution of inflammation; the inelastic structure of the tunica albuginea accounts for the excessive pain in testitis.

361. The *diseases of the testis* are—*acute testitis*, (*orchitis*, or *hernia humoralis*), and *chronic inflammation* (*sarcocele*), *abscess*, *fungus*, (or *hernia testis*), *scrofulous testis*, *imperfect descent*, *neuralgia*, *atrophy*, *morbid growths*, *fibrous* and *fibro-plastic cysts*, *enchondroma*, *cancer*.

362. The *diseases* attacking the *scrotum* and *cord* are *hydrocele of the scrotum; hydrocele of the cord;* (*varicocele*)*; hæmatocele; anasarca* of the scrotum, *ecchymosis* of the same; *chimney-sweepers' cancer*, and *tumours*.

363. *Acute testitis*, formerly called hernia humoralis, is attended with intense pain, enlargement, hardness, and tenderness of the testicle; vomiting; swelling of the cord; pain in the lumbar, abdominal, and inguinal regions, costiveness, redness of the scrotum, and inflammatory fever; the pain frequently comes on in paroxysms, which seem to be caused by contractions of the cremaster.

364. The *causes* of testitis are, gonorrhœa, blows, strictures, use of bougies, any kind of external violence, operations, or disordered states of the system.

It may follow metastasis of gonorrhœa, or may *be caused* by the inflammation in that complaint *extending along* the vas deferens.

365. It may be *mistaken* for *congenital hernia*, but it is to be *distinguished* by the *hardness of the swelling; the great pain in the loins;* the *absence* of any *tumour* at the *abdominal ring*, and by the different kind of fever which accompanies it.

When this inflammation *follows gonorrhœa*, it rarely terminates in *sloughing*, but when caused *by violence*, it may do so.

366. *Treatment*, consists in pursuing a strictly antiphlogistic course, but great benefit has been found from compression by means of plasters and bandages; local bleeding is of little service till free venæsection has been first made; support is very important, and if the patient cannot lie in bed, he must wear a suspensory bandage, puncture of testis frequently of service. (H. Smith.)

367. *Chronic testitis* (sarcocele) frequently syphilitic, sometimes rheumatic, sometimes follows acute, or is a *primary* affection, beginning in the cord; in the commencement, the enlargement is tuberculated, but acquires uniformity as it increases in size; after this complaint has existed some time, pain in the loins and thighs is felt.

In some cases, the structure remains uninjured, but in others there is, according to Cruveilhier, deposits of *yellow tubercular matter* in its interior; according to this author also, *venereal sarcocele* is only a variety of it; it often occurs in persons of a rheumatic or scrofulous diathesis, or whose constitutions have been injured by mercury.

It may *terminate* in suppuration, which is very slow in progress, but may be *cured* in the early stages by small doses of calomel, purgatives, local bleeding, lotions, and rest; in a more advanced period, castration may become necessary.

368. *Atrophy* may follow acute inflammation arising from any cause, but generally that which results from violence, or it may be caused by ulceration. Little or nothing can be done for this affection, unless by using the organ and applying stimulants.

369. *Neuralgia* is characterized by intense pain of testicle, without swelling or alteration in appearance; the treatment is the same as that for neuralgia in general.

370. *Fungus testis*, composed of tubuli seminiferi and of fibroplastic matter, may follow the bursting of an abscess, or chronic inflammation; must be treated with applications of ung. hydrargyri nitrico-oxydi, nitrate of silver, and pressure; or by Syme's operation, of vivifying the edges of the skin on either side of the fungus and bringing them together across it.

371. *Hydatid disease* appears at adult age, and is known from *hydrocele* by its attachment to the testicle, by its uneven feel, by its not being pyriform in shape, and by its weight. It is a local disease, and is caused by enlargement or distension of the seminiferous tubes. No treatment except *excision* is of any use.

372. *Scrofulous inflammation* is very slow in *progress*, generally begins in the epididymis, and

is succeeded by formations of abscesses, fistulous sinuses, fungous granulations, or atrophy.

373. *Syphilitic inflammation* attacks the tunica albuginea and body of testis; it is known by the increase of pain at night, and by its being accompanied with other secondary syphilitic symptoms.

373 *bis*. *Enchondroma* or cartilaginous tumour has a peculiar predilection for the testis. No treatment but excision.

374. *Cancer* almost always *medullary*, begins in the body of the testicle, but extends to the epididymis, and then assumes a pyramidal shape; it is accompanied by darting pains along the testicle, up the spermatic cord, and as far as the lumbar region; the swelling becomes softer and adherent to the scrotum, and is complicated with effusions into the tunica vaginalis; finally, ulceration commences, a fungous growth protrudes, from which copious hæmorrhages take place, and the patient sinks.

This is a malignant disease, and is known in its early stages under the name of *medullary sarcoma;* it may be distinguished from *hydrocele* by its shape being *oval,* till the epididymis is attacked, and by its being *opaque;* from *hydatids,* by the darting pains and constitutional derangement; from *inflammation,* by the hardness in the first stage and softness in the second, and by the nature of the pain.

It must at once be removed, but before doing so, the disease may be exposed to make certain of its nature.

375. *Scirrhus*, attacking the testicle, rarely occurs before the age of fifty; there are acute lancinating pains, stony hardness, slowness of progress, adhesion, and alteration in colour of skin, with great inroads in the general health; after remaining stationary for a long time, it may ulcerate and terminate in the preceding affection.

376. *Castration* is performed thus: an incision is to be made from the external abdominal ring to the bottom of the scrotum; the cord is to be laid bare, and a ligature passed through it to prevent its retraction into the inguinal canal when divided; it must then be cut through, the lower portion drawn forward, and the testicle detached; the arteries which require ligatures are the spermatic, deferential, and external pudics; the wound is to be closed with two or three sutures, when bleeding has ceased.

377. *Hydrocele of the tunica vaginalis* is a collection of serous fluid between the two layers of the membrane. It is pyriform in shape, transparent, fluctuating, commencing at the lower part of the scrotum, and lighter than where the testis is diseased.

The fluid is sometimes thick and opaque, from inflammation of the tunica vaginalis; and contains albumen and cholesterine.

378. *Diagnosis* from *hernia* (302); from *hæmatocele* (382); from *enlarged testicle*, by its transparency, lightness, and shape; by the testis being situated at the back in hydrocele; by the flattened

sides, hardness and weight of the diseased testis, and by the sickening sensation communicated when it is touched.

When hydrocele and hernia are *combined,* the former is *in front.*

379. *Treatment.—In children,* absorption may be procured by purgatives and alteratives, lotions of ammonia, iodine, or cantharides, and by blistering.

In adults, the disease will not yield to such remedies, but requires *evacuation of the fluid,* and injection of sulphate of zinc or port wine and water, or still better tinct. of iodine one drachm, to produce adhesive inflammation between the tunica vaginalis testis and reflexa.

The operation of tapping for hydrocele is performed by grasping the testicle with the left hand, making tense the sac—then introducing the canula and trocar in a direction upwards and backwards, and afterwards injecting one of the above fluids.

This constitutes the *radical* treatment; where no injection is used, it is called the *palliative.*

Repeated punctures with a needle have also been recommended for its cure, which they effect by allowing the fluid to exude into the cellular tissue, whence it is absorbed.

380. *Congenital hydrocele* is that where the peritoneal canal through which the testicle has passed remains open after birth, and allows of the passage of fluid into the scrotum.

By pressure, the fluid may be returned into the abdomen; a truss should be applied, and as soon as the communication with the abdomen is closed, the operation may be performed.

381. *Hydrocele of the cord* results either from imperfect closure of the peritoneal coverings of the cord, and by adhesion having taken place after some fluid has passed down, or it may form at this part like any other cyst.

The fluid *in this hydrocele* is more limpid, and contains less albumen than in the scrotum, and spermatozoa can be detected in it. *Treatment,* is to pass a seton through it, to lay it open and fill the cavity with lint, or to remove a portion of the cyst.

382. *Hæmatocele* is a collection of blood in the tunica vaginalis; it is heavier, more opaque, and less fluctuating than hydrocele; it comes on suddenly, and is generally the consequence of a blow. *Treatment.*—The inflammation to be subdued, and absorption procured by leeching, application of cold, or by incision.

383. *Varicocele* is an enlargement of the *spermatic veins;* it is more common on the left side, because that testis is lower; because its veins pass into the left renal vein, whilst those on the right pass into the inferior cava (361), and because it is pressed on by the colon. *Treatment.*—A suspensory bandage and laxatives, with obliteration of the veins, if very severe.

384. *Fistula in ano* is a fistulous tract by the side of the rectum through the fibre of the sphincter ani: the varieties are (1) *complete*, (2) *blind ex-*

ternal, (3) *blind internal;* the 1st has an opening near the anus and another into the bowel, the 2nd has no opening into the bowel, and the 3rd opens into the bowel, but not externally.

There is a tendency in some persons to this disease, but any *irritating cause*, as *dysentery*, *piles, strictures of the rectum, obstinate diarrhœa*, or *visceral disease*, may give rise to it.

Free division of the sphincters, which prevent it healing, must be made before it can be cured, but the operation must not be performed if any organic disease exist.

385. *Strictures of the rectum* are generally situated about four inches above the anus, but they may be placed at any part of the gut. Bougies, mild aperient medicines, injections, and divisions of the obstruction are recommended in this complaint. When abscesses have formed to a considerable extent round the anus, and the mucous membrane is ulcerated, they rarely admit of a cure.

386. *Hæmorrhoids* are either *internal* or *external;* the *internal* are situated above the sphincter ani, and are veins in a state of varicose enlargement; they vary in size from that of a pea to a small egg, and are frequently many in number.

The *external* differ in colour from the preceding, are placed below the sphincter ani, and seem more like fleshy growths.

The *causes* are—obstruction of blood through the vena porta or liver; constipated state of the bowels; anything which tends to induce plethora or irritation; the gravid uterus; the use of aloetic purgatives, and an indolent and sedentary life. The internal kind are attended with frequent bleeding, which sometimes proceeds to a great extent.

Treatment.—Ligatures, excision, Smith's clamp and cautery, stimulating and astringent ointments, as Unguentum Gallarum, or lotions and fomentations, nitric acid.

387. *Chimney-sweepers' cancer* comes on with induration of some part of scrotum; ulcerations form, spread, and discharge their ichor; the disease extends to the testicle, to the glands in groin, and perhaps to the arteries; it is of a malignant nature, and incurable. Excision offers the only chance of relief.

CHAPTER XIV.

ON THE BRAIN AND SPINAL CORD.

388. THE *investments* of the brain are—1st, the *Dura Mater* *μήνιγξ σκληρη*; 2nd, *Arachnoid*, 'Αράχνη a spider's web, *εἶδος* like; 3rd, *Pia Mater*, *μήνιγξ λεπτη*.

1st, *Dura Mater* is a firm, dense, unyielding, fibrous membrane, closely applied to the internal surface of the cranium; its uses are 1st, *to perform the office of an internal periosteum* to the bones; *2nd, to envelope and sustain* the brain; 3rd, *to* *send different processes* between its lobes and to *keep them in position;* 4th, *to form the sinuses;* 5th, *to protect the nerves* as they emerge at the different foramina, round which they form tubular investments, through the bone; 6th, *to form the theca vertebralis;* 7th, to form the *investment of the optic nerve,* and *expand* into the *sclerotic* coat.

The *processes* sent down are, the *falx cerebri,* between the two hemispheres; the *tentorium cerebelli,* which separates the cerebrum and cerebellum; the *falx cerebelli,* extending down from tentorium to foramen magnum, and separating lobes of cerebellum.

389. The *sinuses* are formed by splittings of the dura mater, in which is a membrane similar to and continuous with that which lines veins; they are *sixteen* in number—viz., the superior and inferior longitudinal, straight, two lateral, two occipital, circular, two cavernous, two superior and two inferior petrosal, transverse, and torcular Herophili; the *superior longitudinal* is of a triangular shape; commencing at the crista galli of the ethmoid, it empties itself into the torcular Herophili; in it are seen the tendinous chordæ Willisii and the oblique openings of the cerebral veins; *the inferior,* in the lower border of the falx, empties itself into the *straight* sinus, which also terminates in the torcular Herophili; *the lateral sinuses* extend from the torcular to the foramen lacerus posterius; *occipital* runs in the falx cere-

belli, one on each side; *circular* surrounds the pituitary gland; *cavernous* are situated on each side of the sella turcica; between its lining membrane and outer investment run the 3rd, 4th, first division of 5th, and 6th nerves;—the *superior petrosal* run along the upper margin of petrous portion of temporal, and terminate in the lateral sinuses; the *inferior petrosal* empty themselves into the lateral sinus as they pass into the foramen lacerum posterius; *transverse* runs across the basilar process, and connects the petrosal with the cavernous; the *torcular Herophili* is formed opposite the internal occipital protuberance by the meeting of the other sinuses.

390. The *internal* surface of the *dura mater* is smooth, from its being inseparably connected with one of the layers of the arachnoid membrane; it is closely attached to the sutures, but is easily separated at other parts; on its external surface are seen the *glandulæ Pacchioni.*

391. The *arachnoid,* placed between the dura and pia mater, is a *serous membrane,* and is therefore a closed sac, one surface being in contact with the dura mater, the other lying upon the pia mater, and extending across from one convolution to another; it passes down the spinal canal as far as the cauda equina, and also into the transverse fissure of brain.

392. The *pia mater* is vascular in structure, dips down into the convolutions, assists in forming *the theca vertebralis,* invests the nerves with the

neurilemma, and in the interior of the ventricles takes the name of *choroid plexus.*

393. *Extravasation of blood* from the meningeal artery occurs between the dura mater and bone; effusion of serum between the two layers of arachnoid.

394. *Corpora Pacchioni* are seen in the arachnoid and in the sinuses.

395. The *theca vertebralis* is formed by all three membranes; the dura mater is continued into the sacral canal, and is retained in its situation by the processes which pass out at each intervertebral foramen; the arachnoid and pia mater also pass down to the point where the nerves emerge from the foramina.

396. *Ligamentum denticulatum* appears to be a membrane, attached to the dura mater externally, by pointed processes, and internally, to the spinal cord, between the anterior and posterior roots of the nerves; it extends from the foramen magnum to the first lumbar vertebra.

BRAIN.

397. The *external* surface of the brain is convex; it is broader behind than in front, fills the cranial cavity as low as the tentorium cerebelli, and is separated into two hemispheres by the falx; upon it are seen the convolutions and sulci, or grooves, between them; the internal surface of each hemisphere is flat; between, and connecting them together, is the *corpus callosum*, upon which

is seen the anterior cerebral artery; this body, sometimes called *commissura magna*, passes into each hemisphere, and forms the roof for the lateral ventricles.

398. The *lateral ventricles,* two in number, are separated by the septum lucidum; on *the floor of each* in the anterior horn is the corpus striatum, thalamus nervi optici, tænia semicircularis, and choroid plexus; in the *posterior horn,* the hippocampus minor; *in the descending,* the hippocampus major, pes hippocampi, corpus fimbriatum, fascia dentata, and choroid plexus. The *anterior horns diverge,* the *posterior converge,* and the *descending* pass backwards, outwards, then in a line downwards round the posterior part of thalamus, and running inwards and forwards, *terminate at the fissure of Silvius.*

399. The *third ventricle* is placed between the thalami nervorum opticorum; it is bounded *above* by the fornix and velum interpositum; *below,* by the pars perforata postica, by the corpora albicantia, and tuber cinereum; *anteriorly,* its upper and lower boundary approximate; here are the anterior pillars of the fornix, which are reflected down, to invest the corpora albicantia; at the anterior part of this ventricle is the *anterior commissura;* between the thalami is the *commissura mollis,* and at the back is the *commissura posterior;* the openings into it are the *foramen of Monro,* forming a communication through the pillars of the fornix, between the two lateral ventricles and it, *the iter*

a tertio ad quartum ventriculum beneath the posterior commissure, the *iter ad infundibulum*, and *the fissure of Bichat*, or transverse, through which the velum interpositum enters.

400. The *fourth ventricle* is bounded *above* by the *valve of Vieussens, laterally* by the *processus e cerebello ad testes;* below, by the *medulla oblongata*, on which is seen the *calamus scriptorius*, and by a reflection of the arachnoid membrane.

The fifth ventricle is merely a fissure in the septum lucidum.

401. The *fornix* anteriorly terminates in two horns, which descend behind the anterior commissure to the base of the brain, where they terminate in the corpora albicantia, and posteriorly divide *into two lateral portions* which pass to the descending cornu forming the corpus fimbriatum, and an *intermediate one*, which is *continuous with* the *corpus callosum;* on its inferior surface is the *velum interpositum*, and an appearance called lyra.

402. The *thalami nervorum opticorum* are situated on the upper surface of each crus cerebri, and are *oval* in shape; they are connected by the soft commissure, and present on their posterior part the *corpus geniculatum internum* and *externum*.

403. The *tubercula quadrigemina* are four bodies, the two anterior being called *nates*, the two posterior *testes;* they are placed between the third and fourth ventricles, and have resting upon them the *pineal gland*, which contains in its interior

sabulous matter, and is connected to the thalami by peduncles.

404. The *pituitary gland* is situated in the sella turcica, and is attached to the tuber cinereum by the infundibulum.

405. The *cerebellum* has an arborescent appearance, from the alternate arrangement of the white and grey fibres, which is called arbor vitæ; it is situated in the occipital fossæ, and is divided into two lobes, connected above and below by the superior and inferior vermiform processes; its fibres are arranged in numerous *laminæ*, separated from each other by the pia mater passing between.

It is attached to the brain and spinal cord by —1st, *the inferior peduncles* or corpora restiformia, which form the posterior part of the medulla oblongata, and are continued down into the posterior pyramids of the cord; 2nd, by the *middle crura*, which pass to, and invest, the pons Varolii; 3rd, by the *superior peduncles* or processus e cerebello ad testes; externally the cerebellum is convex, and in its interior is seen a body called *corpus rhomboideum.*

406. *Pons Varolii* placed like a knot upon the under and anterior surface of the medulla oblongata, immediately before it divides into the two crura cerebri; externally, it is formed by the middle peduncles of the cerebellum, and internally by the anterior pyramids and the olivary bodies.

407. The *crura cerebri* are formed by the splitting of the fibres of the anterior pyramids and

corpora olivaria after leaving the pons Varolii; upon the superior surface of each is seen the thalamus opticus.

408. *Locus perforatus posticus* is the space between the two crura cerebri.

409. *Corpora albicantia* are two small round bodies situated in front of the preceding, and are formed by the anterior pillars of fornix.

410. *Tuber cinereum* placed between the corpora albicantia and the optic commissure, gives attachment to the upper end of the infundibulum, the lower being connected to the pituitary gland.

411. *Locus perforatus anticus* is a quadrilateral space, formed by the divergence of the optic nerves posteriorly, and that of the anterior lobes anteriorly.

412. The *fissure of Silvius*, the groove between the anterior and middle lobe of the cerebrum, corresponds to the lesser wings of sphenoid bone (40).

413. The *medulla oblongata* is the upper extremity of the spinal cord, but situated above the foramen magnum; its diameter is larger than that of the cord. In its forepart are the two *anterior pyramids*, which extend down the front of the spinal cord for its whole length; on the outer side of these are the origins of the ninth or lingual, and in the same groove, lower down, rise the motor nerves of the spine; external to the anterior pyramids, on each side, is an oval-shaped body, called *corpus ovilare*, and between this and the posterior pyramid, or *restiform body*, is the groove in which

rise the *nerves* of respiration, or those which are intermediate to the sensitive and motor nerves in function.

The *anterior pyramids* and *corpora olivaria* are continued through the pons Varolii, into the hemispheres of the cerebrum, the posterior pyramids or restiform bodies into the cerebellum.

414. The substance of the brain, cerebellum, spinal cord, and nerves, is of two kinds, *cineritious* and *medullary.*

The *cineritious* is softer, darker, and more vascular than the medullary; it is not like the other, continuous, but is found wherever the central extremities of the nerves are inserted.

In the cerebrum and cerebellum the *grey* or *cineritious substance* envelopes the medullary, but in the spinal cord it is enveloped by the white; it is discovered by the microscope to be globular in structure. In the medulla and in the peduncles of the cerebrum and cerebellum the structures are found alternate.

In the ganglia the *grey* is traversed by the *white,* and in the nerves, *white* fibres alone occur.

The *white substance* is fibrous, and is composed of a neurilemma investing a soft homogeneous nervous matter.

SPINAL CORD.

415. The *spinal cord* extends from the foramen magnum to the second lumbar vertebra, where it *terminates* in the *cauda equina*; it is divided into

two lateral halves by the *anterior sulcus* passing deeply into its structure, and extending its whole length, and by the *posterior sulcus*, which is less distinct; on each side of these are slight grooves, which are for the origin of the *anterior* and *posterior filaments* of the nerves; the anterior giving origin to motor, the posterior to the sensitive nerves. In the interior of the cord, the grey matter assumes crescentic forms in each lateral half, which are connected together by a commissure; the *posterior horns* of this crescent touch the posterior lateral grooves from which the sensitive nerves arise.

416. The nerves are of three kinds; those which communicate *sensation*, those which communicate *motion*, and the *sympathetic system*. In addition to these, are some of the cerebro-spinal system, which do not arise in the ordinary track, and have an intermediate function; they are called by Sir Charles Bell respiratory or irregular nerves.

417. The *nerves of motion* arise from the *anterior* lateral furrow of the spinal cord, or from the *cerebrum*, which is a prolongation upwards of it; the *nerves of sensation*, arise from the *posterior lateral furrow*, or from the *cerebellum*, which is a prolongation of it; the nerves of *respiration* arise in the groove *between* the motor and sensitive.

418. *Ganglions* are placed upon all the sensitive nerves, but are never found upon motor ones; no difference in structure has ever been perceived by the microscope, but at their origins

they seem to consist of two sets of fibres, one of which is connected to the grey, the other to the white substance.

419. The *cerebro-spinal system* of nerves consists of forty pair placed symmetrically on each side;—they are, nine pair of cerebral, eight pair of cervical, twelve pair of dorsal, five pair of lumbar, six pair of sacral.

Of these, the 1st, 2nd, and *portio mollis* of the 7th preside over the sense of *smell*, *sight*, and *hearing*; the 3rd, 6th, and 9th over motion; the 4th, *portio dura* of the 7th, and part of the 8th, are the *nerves of respiration* of Sir C. Bell; the 5th cerebral and the whole of the spinal are mixed nerves, having *motor* and *sensitive* filaments.

CEREBRAL NERVES.

420. 1st pair, or the *olfactory*, arise by three roots, *external* from middle lobe along fissure of Silvius, *internal* from pars perforata antica, *middle branch* from grey matter at the posterior part of anterior lobe; it passes in a groove on the under surface of this lobe, and upon the cribriform plate forms a bulb, from which three sets of branches pass to the nose, the internal to the septum, the middle to the roof, and the external to the walls; it is triangular in shape; has no neurilemma, and seems to be a prolongation of the cerebral substance alone.

421. 2nd, or *optic*, come from the tubercula *quadrigemina*, but as they pass forward receive an

attachment from the corpus geniculatum externum; they wind round the crus cerebri, and immediately in front of the tuber cinereum unite to form the *optic commissure*, from which the optic nerves pass to the globe of the eye through the optic foramen; the fibres of the optic nerve of each side divide into three sets at the commissure, the external pass forward to the nerve of the same side, the middle pass forward to the nerve of the opposite side, the internal turn backwards to the optic nerve of opposite side. Having arrived at the globe of the eye, it expands into the central coat of the retina.

422. 3rd, or *motor nerve* arises from corpus niger in crus cerebri, passes through cavernous sinus (389), enters the orbit at the foramen lacerum anterius, and after passing between the two origins of the external rectus, divides into two branches, the *superior* of which supplies the levator palpebræ and superior rectus, the *inferior*, the internal and inferior rectus, inferior oblique, and sends a branch to the ciliary ganglion.

423. 4th, *Patheticus* arises from the valve of Vieussens, and slightly from the testis; it winds round the crus cerebri, passes first through the cavernous sinus, then through the foramen lacerum anterius, and is distributed to the superior oblique; it is the smallest of the cerebral nerves, and communicates with the ophthalmic nerve in the cavernous sinus.

424. 5th, *Trigeminus* corresponds to the spinal nerves, in having one root from the anterior and

one from the posterior pillar of the medulla oblongata; it emerges at the *side of the pons varolii*, and consists of two distinct portions, of which the sensitive is the largest; this is distinguished by a ganglion, called the Casserian, which envelops it, as it lies on the petrous portion of temporal bone; the ganglionic portion then divides into three branches—the *ophthalmic*, the *superior*, and the *inferior maxillary*.

425. The *ophthalmic branch* passes through the cavernous sinus and the foramen lacerum anterius, after which it divides into the *lachrymal* to the lachrymal gland; the *frontal* to the forehead, escaping through the supra-orbital foramen; the *nasal*, which passes through the two origins of external rectus muscle, gives twigs to the ciliary, to the lenticular ganglion, to the inner angle, called infra-trochlear, and then passes through the anterior ethmoidal foramen to the cribriform plate, runs along by the side of crista galli process, and passes down into the nose, to be distributed to the mucous membrane near the anterior nares.

426. The *superior maxillary* passes from the ganglion through the foramen rotundum (40), across the spheno-maxillary fossa and fissure, enters the infra-orbital canal, emerges from the infra-orbital foramen, between the levator labii superioris proprius and the levator anguli oris, and supplies the cheek and side of nose and mouth; it gives off orbital branches, two of which communicate with Meckel's *ganglion*, and posterior middle and anterior dental.

427. The *inferior maxillary*, the third and largest branch of the ganglion, passes with the *motor portion* through the foramen ovale. As they pass through this opening, the two portions unite, but, immediately beneath, divide into two branches; the external, which consists entirely of motor filaments, give off *temporal, buccal, masseteric*, and *pterygoid branches;* the other separate into the *mylo-hyoid;* the *inferior dental*, which enters the foramen of the same name, supplies the teeth, and emerges at the mental foramen; the *gustatory*, which supplies sensation to the papillæ and mucous membrane, principally at the side of the tongue.

428. 6th, *Abducens*, arises from the groove between the anterior pyramid and pons Varolii, passes forward through the cavernous sinus (389), then through the foramen lacerum anterius, and supplies the external rectus muscle, after passing between its two heads.

429. 7th, consists of *portio mollis* and *portio dura*, or facial; the *portio mollis* arises from the *calamus scriptorius*, on the floor of fourth ventricle, passes through the internal auditory foramen to the *semicircular canals, vestibule*, and *cochlea;* the structure of this nerve is very similar to the olfactory, and has no neurilemma. The *portio dura* arises from the respiratory tract; that is, in the groove between the olivary and restiform bodies, close to the pons Varolii; it *passes through* an opening at the bottom of the

meatus auditorius internus, then along the aqueductus fallopii, and *emerges* at the *stylo-mastoid foramen ;* it then passes through the parotid gland, forms the *pes anserinus,* and divides into temporal, facial, and cervico-facial branches, supplying those parts with motion.

430. 8th, consists of the *glosso-pharyngeal, spinal-accessory,* and *pneumogastric.*

The *glosso-pharyngeal* arises from the tractus respiratorius, between the portio dura and pneumogastric, by several filaments; it passes out at the inner side of the foramen lacerum anterius, lying anterior to the other branches of the eighth, and internal to the jugular vein ; it then passes between the internal jugular and internal carotid artery, runs down on the inner side of stylo-pharyngeus and hyo-glossus muscles to the tongue, and supplies the mucous follicles on its surface ; in this course it communicates with the facial, pneumogastric, and sympathetic, and sends branches to the pharyngeal plexus, to the constrictors of the fauces, to the tonsils, and to the *substance* of the tongue.

431. The *pneumogastric* arises beneath the preceding by ten or twelve filaments, passes through the foramen lacerum posterius, where it is separated from the jugular vein by a process of bone; it then descends upon the rectus capitis anticus major, lying behind the internal carotid artery; it then enters the sheath of the carotid artery, being placed between it and the internal

jugular vein, and behind them both, passing in this situation to the root of the neck (183); the *right* passes *in front* of the first portion of subclavian (188), but behind the arch of the aorta to the *posterior aspect of the æsophagus;* the *left* passes between the left carotid and subclavian artery in *front* of the *arch of aorta* (208), and in front of the œsophagus; the two nerves then accompany the œsophagus to the stomach, through the œsophageal opening in the diaphragm, the left lying in front, the right behind; they then descend to the spleen, pancreas, liver, gall-bladder, and omentum, and, by branches from the right, communicate with the solar plexus. The *branches* of this nerve are—1st, *Filaments* which communicate with the other divisions of the eighth, the lingual and sympathetic, and thus form the *pharyngeal plexus* with the external branch of laryngeal. 2nd, *The descending laryngeal,* which arises a short distance below the foramen, where the pneumogastric presents a ganglionic enlargement, descends behind the internal carotid, passes through the thyrohyoid membrane, and is distributed to the mucous membrane of the larynx, giving off, in its course, branches to the pharyngeal plexus, the inferior constrictor, and crico-thyroid muscles. 3rd, *The cardiac branches,* from the lower part of the neck, pass behind the carotid, and, uniting with branches of the sympathetic, form a *plexus* on the arch of the aorta. 4th, *The recurrent,* or inferior laryngeal, *curves round* the subclavian artery on the right arch of aorta (208) on the left, passes upwards with the inferior thyroid artery, behind the sheath of the carotid, and supplies all the muscles of the larynx, except crico-thyroid; it communicates with the pulmonary plexus, and sends filaments to the œsophagus and trachea. 5th, *Pulmonary branches,* which, with the sympathetic, form the pulmonary plexuses on the back of the root of each lung, and then pass into those organs. 6th, *Œsophageal branches,* forming a plexus on the œsophagus.

432. *Spinal accessory* arises between the anterior and posterior roots of the spinal nerves, as low as the fourth cervical vertebra; passing up between these nerves, it enters the foramen magnum between the posterior roots and the ligamentum dentatum; it then passes through the foramen lacerum posterius, lying in a separate sheath of dura mater; it crosses behind the internal jugular vein, then passes through the sterno-mastoid muscle, across the superior triangular space of the neck (182), and terminates in the trapezius: in its course it inosculates with the lingual, sympathetic, and first cervical nerves, sends filaments to the pharyngeal plexus, and supplies the sterno-mastoid.

433. 9th, The *lingual* arises by several filaments in the motor tract, between the corpus olivare and restiforme, passes out through the anterior condyloid foramen (41), then between the internal *jugular vein* and internal carotid artery, inclines

downwards near the digastric muscles, passes between the mylo-hyoid and hyoglossus, by which last it is separated from the lingual artery: just before entering these muscles, it passes in front of the external carotid artery, hooks round the occipital, and is finally distributed to the muscles of the tongue; it gives off *branches* to communicate with the eighth and sympathetic, at the point where it crosses the occipital artery and the *descendens noni*, which descends upon the sheath of the carotid, and inosculates with twigs from the first and second cervical, called communicantes noni (435).

CHAPTER XV.

ON THE SPINAL AND SYMPATHETIC NERVES.

434. THERE are *thirty-one pairs of spinal nerves*, all of which are compound, being formed by filaments from the motor and from the sensitive tracts. *Ganglions* are formed in the intervertebral foramina on the sensitive filaments, before they unite with the motor: the posterior roots are the largest, and rise by more filaments; after their union they constitute a spinal nerve. The superior spinal nerves are given off nearly horizontally, but they are more oblique lower down, and at the inferior part pass out nearly vertically.

In the intervertebral foramen, each nerve, after the union of its filaments, divides into an anterior and posterior branch, each of which consists both of motor and sensitive twigs; the *anterior*, which form the different *plexuses*, supply the portions of the body *in front* of the vertebræ, the posterior pass backwards to the space *between the transverse and spinous processes*, and supply the muscles situated in that region, inosculating with each other all the way down from the occiput to the sacrum.

435. The *cervical plexus* is formed by the anterior branches of the four superior cervical nerves, which inosculate freely with each other, and communicate with the superior cervical ganglion of the sympathetic: the branches of the plexus are—1st, *superficial;* and, 2nd, *deep;* the former being superficial to the muscles, the latter beneath them. 1st, the *superficial;* (*a*) the *anterior auricular* passes to the space between the lobe of ear and angle of jaw, and enters the parotid gland, to which it is finally distributed after supplying the ear itself; (*b*) the *superficialis colli* crosses in front of the sterno-mastoid, and is distributed to the integuments on the side of the neck, and to the submaxillary region, where it inosculates with the facial; (*c*) *occipitalis minor* passes behind the sterno-mastoid, and terminates in the integuments at the back of the head; (*d*) *clavicular* passes down over the clavicle, and supplies the integuments on the thorax; (*e*) *acromial* to the *acromion* process, and the omo-hyoid and serratus *magnus* muscle.

2nd, *Deep branches* are, *several* to the trapezius and levator anguli scapulæ; the *communicans noni* uniting with the descendens noni (433), and the *phrenic* to the diaphragm.

436. The *phrenic* arises principally from the fourth cervical, but receives twigs from the third and fifth; thus constituted, it lies first between the rectus capitis anticus and scalenus anticus, then passes down in front of the scalenus, and, inclining over to its inner border, crosses the subclavian artery in its first portion, having the subclavian vein in front (188); it then enters the anterior mediastinum in front of the internal mammary artery, runs down between the pleuræ to the middle mediastinum, and from thence to the diaphragm on the pericardium: previously to entering this muscle, the nerve divides into several filaments, some of which supply it, whilst others pass through it; branches of the right phrenic pass through the diaphragm with the vena cava, and communicate with the hepatic plexus; other branches communicate with the solar plexus: the left phrenic nerve is longer than the right, since it passes round the apex of the heart, which inclines to the left side.

437. The *brachial plexus* is formed by the anterior branches of the fifth, sixth, seventh, and eighth cervical and first dorsal; the nerves which form this plexus are much larger than those constituting the cervical; they lie between the scaleni, and extend as far as the coracoid process, where

the nerves are called axillary. Immediately after emerging from the intervertebral foramina, the nerves forming this plexus freely communicate with the sympathetic as it crosses in front of them, and as they pass between the scaleni, are placed above the subclavian artery, and then lie in the posterior inferior triangular space. The *branches* are—*supra-scapular* to the supra-scapular notch, *subscapular* accompanying the subscapular artery, and supplying the muscles in that region; *long thoracic*, or external respiratory, which terminates in the serratus magnus; *short thoracic*, to the muscles at the upper part of thorax; the *median*, *ulnar*, *musculo-spiral*, or *radial*, *internal* and *external cutaneous*, and the *circumflex* to the upper extremity.

438. The *dorsal nerves* are twelve on each side; they are not so large as the preceding, but, like them, divide into anterior and posterior branches; the anterior branches, after communicating with the sympathetic ganglia, pass along the intercostal spaces, at first lying along the lower border of a rib, and then along the upper border of the rib below, and between the intercostal muscles; midway between the vertebræ and anterior extremity of rib, the nerves divide into superficial and deep branches; the latter pass onwards to the sternum, supplying the triangularis sterni and pectoral muscles; the superficial of the *first unites* with the brachial plexus, those of the *second* and third pass into the axilla under the

name of "*nerves of Wrisberg*," and supply the integuments of the arm as far as the elbow; the remaining superficial ones supply the superficial muscles of the thorax and abdomen, and the last communicates with the next spinal nerve.

439. The *lumbar plexus*, formed by five in number on each side, rise like the preceding, but pass more obliquely: after dividing into anterior and posterior branches, the anterior unite with each other and form a plexus lying on the transverse processes, and covered by the psoas muscle; in this situation they communicate with the lumbar ganglia of the sympathetic, and divide into—(*a*) musculo-cutaneous; (*b*) external cutaneous; (*c*) genito-crural; (*d*) anterior crural; (*e*) obturator; and (*f*) lumbo-sacral.

(*a*) *Musculo-cutaneous* are two in number, and generally derived from the first lumbar; they run parallel to each other as far as the crista ilii, supported on the quadratus lumborum; the external supplies the transversalis and iliacus, and at the anterior *spine of ilium* sends a branch along the crural arch to the external abdominal ring, between the transversalis and internal oblique muscle; it then passes out with the spermatic cord as far as the *integuments of the scrotum*, or the *labia* in the female; the internal branch, which passes along the crest of ilium and is distributed to the abdominal muscles; (*b*) *external cutaneous* passes along the iliacus and into the thigh beneath Poupart's ligament, and there becoming cutaneous, supplies the integuments of the front and outer part of thigh, as far down as the knee; (*c*) *genito-crural*, principally from second lumbar nerve, passes down on anterior surface of psoas muscle to Poupart's ligament, where it divides into a cutaneous and a scrotal branch: the former passing beneath the ligament, supplies the integuments on the inner side of thigh; the scrotal one accompanies and supplies the cremaster muscle and spermatic cord.

(*d*) *Anterior crural*, a large nerve arising from second, third, and fourth lumbar, runs down on the outer side of the psoas muscle, passes beneath Poupart's ligament, lying in a groove between the psoas and iliacus; it gives off *cutaneous* branches to the front and inner side of thigh, *muscular branches* to the muscles on the front of thigh, the *long saphenous nerve* which runs down with the femoral artery to the knee, and then passing between the tendons of sartorius and gracilis, accompanies the internal saphenic vein as far as the integuments on the inner side of foot and great toe; the *short saphenic*, lying external to the sheath, supplies the vastus internus down to the knee.

(*e*) *Obturator* runs parallel to the brim of the pelvis, passes through the obturator foramen, and then divides into two branches to supply the muscles on inner side of thigh, and to join the saphenic nerve; (*f*) *lumbo-sacral*, a large branch *joins the* sacral plexus, and gives off the gluteal which passes out of the sciatic notch, and supplies the two deep gluteal muscles.

440. The *sacral plexus* is formed by six nerves on each side; the posterior branches are small, and pass out at the posterior sacral notches; the anterior, which form the plexus, emerge between the origins of the pyriformis, and then lie on that muscle and behind the pelvic fascia.

The *branches* are, (*a*) *internal pudic;* (*b*) *greater* and (*c*) *lesser sciatic* nerves. (*a*) *Internal pudic* passes out of great sciatic notch beneath pyriformis muscle, enters again at lesser notch, and is distributed to the same parts as artery, following its course throughout; posterior cutaneous arises sometimes separately, but sometimes comes from lesser sciatic; it supplies the integuments at the back of thigh; (*b*) the *great sciatic* is the largest nerve in the body; it passes out beneath the pyriformis muscle, and runs midway between the great trochanter and tuberosity of ischium down the back of thigh to supply the leg and foot; (*c*) *lesser sciatic* passes out beneath pyriformis at the great sciatic notch, gives off inferior gluteal to the gluteus maximus, two or three cutaneous branches, and cutaneous branch to perineum and scrotum.

THE SYMPATHETIC NERVE.

441. Numerous ganglia, with connecting branches which extend from the cranium to the coccyx, form this system of nerves; the viscera of the head,

neck, chest, abdomen, and pelvis, are supplied with branches from it, and numerous filaments join the other nerves, but no distinct branches have been traced into the extremities.

Meckel remarks that this nervous system is smaller in proportion as the animal scale recedes from man, and that it is developed in all animals in proportion to their circulatory system.

According to Béclard, "the functions of the sympathetic are to direct nutrition and secretion; to distribute the nervous agents to the heart, the digestive canal, and the urinary and genital organs, and to establish a sympathetic connexion among all the principal organs; also that it has a sphere of action of its own, but that the two nervous systems are intimately connected, and exert a reciprocal action, especially in disease."

As the filaments are plentifully distributed to the coats of arteries, and to the involuntary muscles, it is supposed by many to preside over involuntary action, and over the vital functions, constituting the "system and seat of organic life, and maintaining a sympathy between the different organs."

The *sympathetic ganglia* resemble in colour the cineritious portion of the brain, and are invested by cellular tissue; by maceration they appear to consist of filaments with greyish pulpy matter interposed.

442. The ganglia are fifty-eight in number, which are distributed thus:—six cranial, viz., 1st,

the ganglion of Ribes ; 2nd, *the lenticular ;* 3rd, *the naso-palatine ;* 4th, *the spheno-palatine ;* 5th, *the submaxillary ;* and 6th, *the otic ;*—six *cervical*, viz., two superior, two middle, and two inferior; twelve *pair of dorsal ;* five pair of lumbar; four pair of sacral; the ganglion impar; the two *semilunar ;* and the *cardiac ganglion.*

443. *Cranial ganglia.*—1st, the *ganglion of Ribes*, situated on the anterior communicating artery, inosculates with the carotid plexus, Vidian, and lenticular; 2nd, the *lenticular ganglion*, between the optic nerve and external rectus muscle, communicates with the ophthalmic, the third, and the carotid plexus; it also sends into the globe of the eye, with the ciliary arteries, nerves of the same name.

3rd, The *naso-palatine* (or Cloquet's) in the foramen incisivum, is distributed to the palate, and communicates with the spheno-palatine branches from Meckel's.

4th, The *spheno-palatine* (or Meckel's), placed in the spheno-palatine fossa, gives descending or *spheno-palatine* branches, which pass through the posterior palatine canal to the mucous membrane of the mouth and palate; *internal* or *nasal*, which pass through the spheno-palatine foramen to the nose; *two ascending*, which join the second division of the fifth, as it crosses the spheno-maxillary fossa; a *posterior* or *Vidian*, which passes backwards through the pterygoid foramen (41) to the foramen lacerum medius;—at this point it divides into two branches, the *carotid*, which accompanies the carotid artery and joins the carotid plexus, the *other*, which enters the *hiatus Fallopii*, or Vidian foramen, passes along the aqueductus Fallopii to the posterior part of tympanum, accompanying the portio dura; it here leaves the canal, enters the tympanum, runs between the incus and malleus, emerges at the *Glasserian fissure*, accompanies the gustatory nerve to the under surface of the tongue, then enters the submaxillary gland, where it unites with, or forms the 5th, or *submaxillary ganglion*.

6th, *Otic*, is situated immediately beneath the foramen ovale on the inner surface of the inferior maxillary artery.

Upon the internal carotid artery the filaments are numerous, forming the *carotid plexus*, which, *above*, communicate with the Vidian, lenticular, and ganglion of Ribes; *below*, with those in the neck.

444. *Cervical ganglia* are—1st, *superior cervical*, more than an inch and a half in length, which lies about half an inch below the cranium upon the rectus capitis anticus major, having the internal carotid in front; branches pass *upwards* on the carotid artery to join the carotid plexus; *downwards*, which pass on the rectus capitis, behind the sheath of the carotid to join the middle cervical; *externally* and *internally*, which communicate with the 8th, 9th, cervical, spinal, pharyngeal, and laryngeal branches; filaments pass along the carotid artery, which are called *nervi molles*, and another, called superior cardiac, descends to the heart.

2nd, *Middle cervical ganglion*, sometimes wanting, rests upon the inferior thyroid artery, opposite the fifth cervical vertebra; it communicates with the superior and inferior cervical ganglia, and the spinal nerves, and gives off the *middle cardiac*.

3rd, The *inferior cervical ganglion* is placed beneath the preceding, and behind the vertebral artery; it sends branches on the subclavian and vertebral arteries, communicates above with the middle cervical, and below with the thoracic ganglia, and gives off the *inferior cardiac*.

The cardiac nerves pass down the neck behind the carotid artery, parallel with the trachea, enter the thorax behind the arteria innominata, and form upon the arch of aorta the cardiac plexus, by some described as a ganglion.

445. *Thoracic ganglia*, twelve in number on each side, are placed in front of the heads of the ribs; they communicate with each other, with those in the neck, with the lumbar below, with the spinal, and give off in front the greater and lesser splanchnic nerves.

The *great splanchnic* is formed by branches from the 6th to the 10th, uniting to form one large nerve, which passes down the posterior mediastinum, pierces or passes between the crura of the diaphragm, and terminates in the semilunar ganglion.

The *lesser splanchnic*, formed by filaments from the 11th and 12th dorsal ganglia, pierces the diaphragm external to the other nerve, and terminates in the renal plexus.

446. The *lumbar ganglia*, similar to the dorsal, and five in number on each side, are situated in front of the transverse processes, on the sides of the bodies of the lumbar vertebræ; they communicate with the dorsal and sacral ganglia, spinal nerve, and aortic plexus.

447. The *sacral ganglia*, four on each side, lie on the front of sacrum; they communicate with the sacral plexus, and with the lumbar, and give off numerous branches, which help to form the hypogastric plexus to supply the viscera.

The ganglion impar is situated on the front of the first bone of coccyx, and communicates with the sacral ganglia from each side.

448. The *semilunar ganglia*, two in number, are placed by the side of the cœliac axis, and communicate freely with each other; the *branches* from these ganglia constitute the *solar plexus*, which is connected above by the splanchnics to the rest of the sympathetic, and sends off numerous filaments to form plexuses and supply the whole of the abdominal viscera; they are, *phrenic*, *cœliac*, *gastric*, *hepatic*, *splenic*, *aortic*, formed by greater splanchnic; *renal* and *spermatic*, which have, in addition to these branches, the lesser splanchnic; the *hypogastric plexus*, which distributes its branches to the pelvic viscera, is formed by *branches* from the *aortic* plexus, and *lumbar*, and *sacral* ganglia.

CHAPTER XVI.

THE UPPER EXTREMITY—THE ARM AND AXILLA.

449. THE *axillary space,* at the upper and lateral part of the thorax, is triangular in shape, and is formed by the muscles which attach the upper extremity to the body, and by the walls of the chest; it is bounded *in front* by the pectoralis major and minor; *behind* by the latissimus dorsi, teres major, anterior edge of the scapula, and subscapular muscle; *internally,* by the serratus magnus, intercostals, and ribs; *inferiorly,* by the fascia, which extends across from the lower margin of pectoralis major to that of teres major; and *superiorly,* its apex is formed by the shoulder-joint, and the interval between the clavicle and first rib, through which the vessels pass.

The *contents* of this cavity are, axillary artery and branches, vein, nerves, absorbent vessels, and glands, loose cellular tissue, and nerves of Wrisberg.

450. The *axillary artery,* a continuation of the subclavian, extends from the lower border of the first rib to the lower border of the teres major. When the arm hangs down by the side, it describes a *curve* corresponding to the thorax, but when the arm is thrown out from the side, it

passes in a straight line; in this course it lies on the first intercostal muscle, then on the serratus magnus; afterwards, passing to the humeral side of the axilla, it lies upon cellular tissue, then upon the anterior margin of subscapularis, then upon cellular tissue separating this muscle from the arm, and finally upon the latissimus dorsi and teres major: in the upper part of its course the *axillary vein lies below* and *in front;* opposite the *middle*, or near the coracoid process, it lies *directly in front;* and opposite the lower third, or after it has passed beneath the pectoralis minor, it has the same *relative situation* as in the upper portion; the *axillary plexus of nerves* lies to the outer side above, and posterior in the first part of its course; opposite the coracoid process, the two heads of the median lie in front, and it is completely surrounded at this part by the plexus; at the lower third, the nerves separate and leave the artery exposed, the ulnar and internal cutaneous lying to its inner side, the external cutaneous and median to its outer behind the circular and musculo-spiral. *At its upper third*, the costo-coracoid ligament and the pectoralis major are in front; opposite the second portion, the pectoralis major and minor; and opposite the third, the pectoralis major alone.

451. The *branches* are seven :—(*a*) thoracica suprema; (*b*) thoracica acromialis; (*c*) thoracica longa; (*d*) thoracica alaris; (*e*) subscapularis; (*f*) circumflexa anterior; (*g*) circumflexa posterior.

(*a*) *Thoracica suprema* emerges above the pectoralis minor, supplies the pectoral muscles, and anastomoses with the internal mammary and intercostal; (*b*) *thoracica acromialis* also emerges above the pectoralis minor, and gives off three sets of branches; the internal set are distributed to the serratus magnus and pectoral muscles, and anastomose with intercostals, internal mammary, and other thoracics; the external pass to the shoulder joint and deltoid, anastomosing with supra-scapular and posterior circumflex arteries; the descending branch runs down between the outer border of pectoralis major and deltoid, by the side of the cephalic vein, which here passes upwards to join the axillary; this branch anastomoses with branches of brachial; (*c*) *thoracica longa*, or external mammary, emerges beneath the pectoralis minor, and supplies the breast, serratus, and pectoral muscles, anastomosing with intercostal and internal mammary; (*d*) *thoracica alar*, consisting of one or more irregular branches, supplies the glands in axilla; (*e*) *subscapularis*, given off opposite the subscapularis muscle, soon divides into a descending branch, which passes down with the nerve of the same name to the inferior angle of the scapula, infra-spinous, the subscapularis, serratus, and latissimus dorsi muscles, and anastomosing with dorsal branch of same artery and posterior scapular; the dorsal branch, which passes backwards through a triangular space formed by teres major, subscapular and triceps muscles, to infra-spinous fossa, where it ramifies, sending branches beneath acromion process to supra-spinous fossa, and anastomosing with supra-scapular and posterior scapular branches of subclavian : (*f*) *circumflexa anterior* passes to neck of humerus, gives a branch which accompanies the biceps muscle to shoulder joint, supplying it; (*g*) *circumflexa posterior* encircles the neck of humerus, passing in a quadrilateral space formed by neck of humerus, tendon of triceps, teres major, and head of bone; some of its branches pass to shoulder-joint, acromial process, and deltoid muscles, others pass round the neck, and anastomose with anterior circumflex, whilst some descend and anastomose with the superior profunda from the brachial.

452. A ligature may be fixed round the axillary artery in the lower third of its course, but the costa-coracoid ligament (183), and the numerous branches given off in the first part, the close manner in which the nerves and vein surround the artery in the second, and the muscles covering both portions, render it difficult and inexpedient to tie the artery in either of those places; the *operation* in the *lower third* is performed by making an incision through the fascia forming the lower boundary, nearer to the margin of the latissimus dorsi than the pectoralis major, whilst the arm is drawn out from the side; the median nerve is to be drawn to the outer, the vein to the inner side, and the ligature passed from within *outwards*.

453. Aneurisms may form in this situation, and suppuration of the glands is not unfrequent; the former may be distinguished from the latter by its being single, situated on the artery, and by the pulsation ceasing when pressure is made on the subclavian.

454. The *deltoid*, extending from the outer third of clavicle and inferior border of acromion and spine, to a rough space on humerus, between origins of brachialis anticus, is of a triangular shape, and divided into several fasciculi by cellular intersections. It is superficial, with the exception of the platysma, and covers the shoulder-joint, the circumflex vessels, the coracoid process, the insertions of the pectoral and the capsular, the coraco-brachialis, and the triceps and biceps muscles; its use is to raise the shoulder, and to prevent dislocation; but when dislocation has occurred, it tends to prevent its return to the socket.

455. The *pectoralis major* arises from sternal third of clavicle, *portio attollens* from front of sternum by an aponeurosis, and from cartilages of second, third, fourth, fifth, and sixth ribs—*portio attrahens* is inserted into outer side of bicipital groove; the platysma lies external to this muscle, but otherwise it is subcutaneous; near its insertion the fibres are twisted, the most inferior being inserted superiorly, and behind the others; *its outer border* is separated from the *deltoid* by the *cephalic vein,* and *descending branch of thoracica acromialis* artery, but beneath the clavicle there is left a *triangular interval*, into

which the cephalic vein dips down, and in which is seen the costo-coracoid ligament. *Use*, to depress the arm, and bring it across the chest, and to assist in extraordinary inspiration.

456. The *pectoralis minor* arises from the bony portion of third, fourth, and fifth ribs, and is inserted into coracoid process. *Use*, to depress the shoulder.

457. Muscles *attached* to scapula are seventeen in number, of which six are inserted—viz., levator anguli scapulæ to superior angle; rhomboideus minor to base, opposite triangular space; rhomboideus major to base, from triangular space to inferior angle; trapezius to superior border of spine and outer border of acromion process; pectoralis minor to coracoid process; and serratus magnus to whole of base: those which arise are eleven in number: they are, deltoid (454); supra-spinatus, from supra-spinous fossa; infra-spinatus, from posterior four-fifths of infra-spinous fossa; teres major, from quadrilateral flat surface on inferior angle; teres minor, from posterior edge beneath infra-spinous; subscapularis, from subscapular fossa; triceps, from inferior costa, immediately beneath glenoid fossa; omohyoid, from ligament crossing supra-scapular notch; biceps, from margin of glenoid cavity and from coracoid process; coraco-brachialis, from coracoid process; and latissimus dorsi, from inferior angle, sometimes only.

458. The *capsular muscles* are the supra-spi-

natus, the infra-spinatus, the teres minor, attached to great tubercle, and subscapularis to lesser tubercle.

459. The *arm* is *raised* by deltoid, coraco-brachialis, biceps, supra-spinatus, infra-spinatus, and teres minor; *drawn down* by triceps, pectoralis major, teres major, and latissimus dorsi: *rotated* by deltoid, pectoralis major, teres major, latissimus dorsi, capsular muscles, and coraco-brachialis. In dislocation into the axilla, the *principal hindrance to reduction* is the spasmodic contraction of pectoralis major, deltoid, and latissimus dorsi.

460. *Beneath the skin,* on the arm, are the nerves of Wrisberg, the cephalic, and sometimes the basilic vein, together with branches of the internal and external cutaneous nerves; *beneath the fascia* are three muscles in front, the biceps, the coraco-brachialis, and brachialis anticus; *behind*, the triceps.

The brachialis anticus is simply a flexor of the forearm; the biceps also performs this action, but from its origins at the margin of the glenoid cavity and coracoid process, raises the arm, and in consequence of its insertion into the posterior part of the tubercle of the radius, *rotates* that bone, and the hand outwards; the triceps has *three origins*, the longest from the inferior costa, the shortest from the humerus, beneath the teres major, latissimus dorsi; the middle from the humerus beneath the teres minor; both these two last origins arise from the humerus down to the condyles; the *insertion* is into the olecranon, where it sends down the fascia on the back of forearm; *its action* is to extend the forearm, and to draw down the arm. The coraco-brachialis is inserted between the inner origin of the brachialis anticus and triceps.

461. *Brachial artery* extends from lower border of tendon of teres major to bifurcation at the bend of the elbow, being the continuation of the axillary; it lies first on the lunar side of humerus, but at the lower part in front of it;—at its *commencement* it is placed on the inner, or *short origin of the triceps,* then upon the *tendon* of the *coraco-brachialis,* and afterwards as far as the elbow upon the *brachialis anticus;* to its *outer side, above,* is the *coraco-brachialis,* to its *inner,* the *triceps;* lower down it is placed *between* the *biceps* and *triceps,* being partly overlapped by the former; the *median nerve* lies to *its outer side, above,* about the *middle of the arm* crosses in *front* of the artery, and in the *lower portion* lies to *its inner side;* the external cutaneous lies superficial and external; the internal cutaneous superficial and internal; the ulnar, deep-seated, and internal; on each side, in close connexion, are the *venæ comites.*

462. The *branches* are numerous, but irregular; those named are, (*a*) superior profunda; (*b*) inferior profunda; (*c*) ramus anastomoticus; (*d*) arteria *nutritia* humeri; the others are called muscular. (*a*) *The superior profunda* is given off a little

below the tendon of the teres major, from the posterior part of artery; after sending off many branches to the muscles of shoulder, which anastomose with the thoracic and circumflex arteries, it passes backwards and outwards between the triceps and bone, with the musculo-spiral nerve; on the outer side it lies between brachialis anticus and supinator radii longus, and terminates by anastomosing with recurrent radial; in this course it gives off numerous branches to triceps muscle, and one *descending branch* to the back part of elbow joint to *anastomose with interosseous artery*; (*b*) *inferior profunda* arises about the middle of the arm, opposite the insertion of coraco-brachialis, pierces the intermuscular septum, and accompanies the ulnar nerve to the space between internal condyle and olecranon, where it anastomoses with posterior ulnar and interosseous *recurrent*; (*c*) *ramus anastomoticus*, given off at the lower third of brachial, pierces the internal intermuscular septum, and anastomoses with anterior ulnar and interosseous recurrent; (*d*) *arteria nutritia humeri*, given off about the middle, passes down in bone towards the elbow-joint; the *muscular branches* are freely distributed to all the muscles of the arm, and keep up the anastomotic communication with the arteries of the shoulder.

463. When a *ligature is fixed* at the *upper* part of brachial, or *lower* part of axillary, the *anastomoses* are, those between the descending

acromial, the circumflex, and the other thoracics, with the superior profunda and the muscular; *if fixed* at the lower part, the *anastomosis* is that between the superior profunda and the radial and interosseous recurrent, and that between the inferior profunda and ramus anastomoticus with the interosseous and ulnar recurrent.

464. The *external cutaneous nerve* (*musculo-cutaneous, perforans Casserii*) pierces the coraco-brachialis, passes beneath the biceps, and, becoming superficial, supplies the integuments on the outer side of forearm.

The *internal cutaneous* generally escapes from the fascia near the axilla, and passes down to supply the integuments on the inner side of forearm.

465. *In front of the elbow-joint,* where the fascia is very dense, in consequence of a semilunar aponeurosis from the biceps uniting with it and extending to the internal condyle, are placed, *superficially,* the cephalic vein on the outer side, the basilic on the inner; *intermediately,* the mediana cephalica, proceeding from the cephalic, and the mediana basilica from the basilic, pass to join the mediana profunda; *beneath* this *last,* but *separated* by the *semilunar fascia,* is the brachial artery, which may readily be felt pulsating, and which renders great caution necessary in opening that vein; the fascia, however, renders the danger less than might be supposed; the mediana cephalica is smaller than the preceding, *but is, for the above reason, better adapted for bleeding.*

In *aneurismal varix,* or varicose aneurism (149), Sir Astley Cooper recommends cutting down upon and tying the brachial, in preference to the wounded artery itself, if pressure will not effect a cure.

466. Troublesome ulcerations and sloughing sometimes occur from a foul lancet, and must be treated as in other parts.

467. *Amputation at the shoulder* is performed in several different methods. Dupuytren passed a two-edged knife opposite the acromion process through the deltoid, whilst the arm was raised at a right angle, and the deltoid grasped; he then, by his incision downwards, separated this muscle from the humerus; afterwards made the other flap, and then tied the arteries. Lisfranc and many others introduce a double-edged knife "at the outer side of the posterior margin of the axilla in front of the latissimus dorsi and teres major," then they cut *upwards,* till it arrives under the acromion, divide the joint, and pass the knife boldly downwards along the external side of the arm, forming the posterior flap; they then pass the knife from behind forwards, at the inner side of the head of humerus, and depressing the handle, complete the anterior flap, an assistant compressing the artery.

Circular amputation has also been recommended by some surgeons; but whatever plan be adopted, it is essential to form a *sufficient flap,* and to *cut the arteries* as *late* in the operation as *possible.*

468. *Amputation at the arm* is made either circular or with a flap; in the former, after the tourniquet or digital pressure has been applied to the brachial artery high up, and an assistant has drawn up the integuments, the surgeon, standing with his left arm towards the patient, makes a circular incision through the skin and fascia; in the second incision he divides the muscles and vessels, and then saws through the bone.

In the flap he inserts the knife, either in front or behind, *down* to the *bone,* then passing it round the bone, he makes the external flap first, and afterwards the internal.

In sawing the bone, the first movement should be from heel to point of the saw, the limb should be well supported, and care taken that no sharp edges or spiculæ are left. Petit remarks, "that the more bone and less flesh removed in the operation the better."

CHAPTER XVII.

THE UPPER EXTREMITY—THE FOREARM AND HAND.

469. THERE are *twenty muscles* in the forearm, divided into five sets of four each; in each set three of them are *long muscles,* extending down the whole forearm; the fourth is a ***short one,*** marked (s); the superficial layer in front consists *of (s)* pronator radii teres, flexor carpi radialis,

palmaris longus, flexor carpi ulnaris; the deep are, flexor digitorum sublimis perforatus, flexor digitorum profundus perforans, flexor longus pollicis, and (s) pronator quadratus.

The *outer set* consists of supinator radii longus, extensor carpi radialis longior, extensor carpi radialis brevior, supinator (s) radii brevis.

The *superficial* layer at the back are, extensor digitorum communis, extensor minimi digiti, extensor carpi ulnaris (s) anconeus.

The *deep set* at back are, extensor ossis metacarpi pollicis, extensor primi internodii pollicis, extensor secundi internodii pollicis, and (s) extensor indicis.

In the superficial layer in front *the short* muscle is a *pronator*, and the most superior; in the deep set the *short* one is also a *pronator* and the most inferior. In the superficial layer at the back the *short* one is the most superior; in the deep set most inferior; in the outer set the *short* one is most superior, and a *supinator*.

The first and last of the superficial set in front are perforated by a nerve.

470. The above arrangement is sufficient to enable the student to remember the names and situation of these muscles, but the division of them into *sets of three each* is best adapted to learn their *uses:* thus, the *flexors* of the *wrist* are the flexor carpi radialis, the flexor carpi ulnaris, and palmaris longus.

The *flexors* of the *fingers* are, flexor digitorum sublimis perforatus, flexor digitorum profundus perforans, flexor longus pollicis.

The *pronators* are, pronator radii teres, pronator quadratus, and the mass of muscles going from the internal condyle towards the radial side of the forearm.

The *supinators* are, tendon of biceps, supinator radii longus, supinator radii brevis.

The *extensors* of the *wrist* are, extensor carpi radialis longior, extensor carpi radialis brevior, extensor carpi ulnaris.

The *extensors* of the *fingers* are, extensor digitorum communis, extensor minimi digiti, extensor indicis.

The *three extensors* of the *thumb* are, extensor ossis metacarpi pollicis, extensor primi internodii pollicis, extensor secundi internodii pollicis.

This division is defective, since it omits the anconeus; but it is useful, as giving the action, and therefore is inserted.

471. The *internal* condyle of the humerus is most *prominent*, and gives *origin* to the *pronators* and *flexors;* the *external* condyle is the *shortest*, and gives origin to the supinators and extensors.

472. The *radius* has attached to it, *in front*, the tendon of biceps to posterior part of tubercle, the supinator radii brevis to space between it and oblique line, the flexor digitorum sublimis to the oblique line, the flexor longus pollicis to space beneath oblique line, the pronator quadratus to inferior fifth of bone; *on the outer side*, the prona-

tor radii teres to rough surface half way down the bone, supinator radii longus to styloid process; *at the back,* the extensor ossis metacarpi pollicis, and the extensor primi internodii pollicis to middle portion.

473. The *ulna* has attached to it, *in front,* the brachialis anticus to coronoid process; pronator radii teres to inner side of same process; the flexor digitorum sublimis to outer side of same process; the flexor digitorum profundus to anterior surface of bone down to lower fourth, pronator quadratus to lower fourth; *at the back,* the triceps to olecranon, the anconeus to triangular surface on outer side of condyle, the extensor carpi ulnaris to space between the posterior and internal ridge and to olecranon, the extensor carpi ulnaris to posterior border, extensor ossis metacarpi to the middle, extensor primi internodii slightly to middle, extensor secundi internodii to middle, extensor indicis to middle, supinator radii brevis close to sigmoid fossa.

474. The *radius* is marked at its lower extremity by several *grooves* for the passage of tendons, which are arranged as follows:—On the outer margin of the bone, close to the styloid process, are two grooves for the tendons of the extensor ossis metacarpi and extensor primi internodii; proceeding backwards is a space between these grooves and the oblique one, in which lie the extensor carpi radialis longior, and brevior; next comes the oblique groove for the tendon of the extensor secundi

internodii pollicis, and between that and the ulna is a groove for the extensor digitorum communis and extensor indicis; between the radius and ulna, on the back, passes the extensor minimi digiti, and upon the ulna itself is a groove for the extensor carpi ulnaris.

475. The *radial artery* continues along the forearm in the same direction as the brachial, but is less in size than the ulnar artery; a line drawn from the middle of elbow to the carpal end of metacarpal bone of thumb, indicates its exact course; when it has arrived at lower end of radius, it bends beneath styloid process, and passing underneath the two extensors of the thumb at that part, emerges on the back of carpus—it then passes between metacarpal bone of thumb and forefinger and between the two origins of first dorsal interosseous to palm of hand, crosses over to ulnar side, and anastomoses with ulnaris profunda branch of ulnar artery, forming deep palmar arch. In the *forearm* it lies successively on tendon of biceps, supinator radii brevis, pronator radii teres, flexor digitorum sublimis, flexor longus pollicis, and pronator quadratus; to its *outer side* is the supinator radii longus and radial nerve, which accompanies its middle third only; to its *inner* the pronator radii teres above, and flexor carpi radialis below. In the palm of the hand it is placed upon the interossei, and is covered by tendons of flexor digitorum sublimis and profundus, median nerve, superficial palmar arch, and palmar fascia.

476. The *branches* are, (*a*) the recurrent radial which passes upwards between the supinator longus and brachialis anticus, to anastomose with superior profunda; (*b*) muscular branches to muscles of forearm; (*c*) superficialis volæ, which passes down beneath a layer of the palmar fascia, but superficial to annular ligament, to anastomose with ulnar artery and form the superficial palmar arch; (*d*) anterior and posterior carpal arteries; (*e*) two dorsales pollicis, running along the dorsal edges of thumb; (*f*) magna pollicis, which divides into two branches to anterior margins of thumb; (*g*) radialis indicis to radial side of index finger; (*h*) interossei to supply those muscles; and (*i*) the perforating, which pass through the dorsal interossei muscles to join the branches on the back of hand.

477. This artery may be *tied* in any part of its course down to the wrist *without dividing* any muscle; the direction is to cut down on the *inner margin* of supinator radii longus; two venæ comites accompany it.

478. The *ulnar artery* runs from the middle of elbow-joint to pisiform bone of carpus, then passing *superficial* to *annular ligament* forms with superficialis volæ *the superficial palmar arch.*

In the *upper half* of its course it lies first upon brachialis anticus, then upon flexor digitorum profundus, and is covered by pronator radii teres, flexor carpi radialis, palmaris longus, and flexor digitorum sublimis; *in the lower part* it first lies upon the flexor carpi ulnaris, then upon the pronator quadratus, and is only covered by fascia which extends across from the flexor carpi ulnaris to flexor digitorum profundus, between which two tendons it lies; in the hand it is covered by palmar fascia. The *ulnar nerve* lies on the ulnar side, and two venæ comites accompany the artery.

479. The *branches* are, (*a*) the ulnar recurrent, anterior, and posterior, to anastomose with anastomotica magna and inferior profunda; (*b*) the interosseous artery, which passes down the interosseous membrane, lying between flexor longus pollicis and flexor digitorum profundus as far as pronator quadratus, where it divides into an anterior and posterior branch; near its origin the interosseous gives off the interosseous recurrent and a dorsal interosseous, the first passing upwards to anastomose with superior profunda, the last passing down on membrane to anastomose with dorsal terminating branch; its anterior terminating branch anastomoses with carpal arteries; (*c*) carpal branches to the wrist; (*d*) muscular branches; (*e*) profunda which passes between flexor brevis and abductor minimi digiti to form the *deep palmar arch* with *radial.* (478.) From the *superficial arch,* which is nearer the fingers than the radial, are given off (*f*) four digital branches, supplying the little, ring, and middle fingers, together with the ulnar half of the forefinger.

480. *Superficial* to the *anterior annular ligament (110)* lie, the ulnar artery and nerve, and *tendon* and flexor carpi ulnaris, and palmaris longus,

and the superficialis volæ artery; *piercing* it, the tendon of the flexor carpi radialis; *beneath* are the tendons of flexor digitorum sublimis and profundus, flexor longus pollicis, and median nerve, and comes nervi mediani, and bursal tissue.

481. The *muscles* of the *hand* are divided into three sets, those *forming the ball* of the thumb, those of *the little finger*, and the intermediate ones.

482. The *four* which form the ball of the thumb are, abductor pollicis, *arising* from trapezium, scaphoid, and annular ligament, *inserted* into base of first phalanx; opponens pollicis or flexor ossis metarcarpi pollicis, *arising* from trapezium and annular ligament, *inserted* into whole length of metacarpal bone of thumb, one surface is covered by preceding muscle, the other rests on flexor brevis pollicis; this last consists of two portions, the external *arises* from trapezium and annular ligament, the other from trapezoides and os magnum, *inserted* by two tendons into each side of base of first phalanx; in each of those tendons is a *sesamoid bone*, and *between* the two portions passes the tendon of flexor longus pollicis; abductor pollicis *arising* from third metacarpal bone, *inserted* into inner side of base of first phalanx of thumb.

483. The *four muscles* on *inner side* of hand are, *palmaris brevis*, consisting of a few fibres, superficial to palmar fascia, *inserted* into skin on inner side of hand; *abductor minimi digiti*, *arising* from pisiform bone and annular ligament,

inserted into ulnar side of base of first phalanx of little finger; *opponens*, or flexor ossis metacarpi minimi digiti, *arising* from annular ligament and unciform bone, *inserted* into whole length of metacarpal bone of little finger; flexor brevis minimi digiti *arising* from annular ligament and unciform bone, *inserted* into base of first phalanx.

484. The *intermediate* muscles are, four lumbricales, which *arise* from radial side of flexor digitorum profundus, and are *inserted* into tendon of extensor digitorum, and the palmar interossei.

485. The *interossei* are divided into *three palmar* and *four dorsal:* the *palmar arise* from the metacarpal bone of one finger, and are inserted into base of first phalanx of same and into extensor tendon; they are, one on the ulnar side of forefinger, the others on radial sides of ring and little fingers; the *dorsal interossei*, four in number, *arise* by *two* origins from adjoining sides of metacarpal bones, and *are inserted* into extensor tendon and first phalanx. There are two to the middle finger, one on the radial side of forefinger, through which the radial artery passes, and one on ulnar side of ring finger: these muscles are adductors or abductors, the *palmar* drawing *towards* the middle or longest finger, the *dorsal* drawing *away* from the same.

486. The *musculo-spiral* or *radial nerve* passes in front of the elbow, between brachialis anticus and supinator longus, and *divides* into (*a*) an anterior, and (*b*) a posterior branch; (*a*) *the anterior*

smaller, after giving off many branches, comes into *contact* with the *radial artery* at the middle of forearm; lower down it passes beneath supinator longus, divides into branches to supply the dorsal surfaces of the thumb, forefinger, middle finger, and radial half of ring finger; (*b*) the *posterior* pierces the supinator brevis, and supplies the deep muscles at the back of forearm as far as wrist.

487. The *ulnar nerve* passes between the olecranon and internal condyle; piercing the flexor carpi ulnaris and lying on that muscle, it comes into contact with the ulnar artery, at the junction of the upper with the middle third; near the wrist it divides into (*a*) a palmar, and (*b*) a dorsal branch: (*a*) the *palmar* passes in front of annular ligament, gives off a deep branch to deep muscles of hand, and supplies both sides of little finger and ulnar side of ring finger; (*b*) the *dorsal branch* passes beneath the tendon of flexor carpi ulnaris to back of carpus, and finally supplies the back of little finger and ulnar side of ring finger.

488. The *Median nerve* lies deep at the elbow joint, between the flexor and extensor tendons, passes between the two origins of the pronator radii teres, and runs down the forearm between flexor digitorum sublimis and profundus; it then enters the palm of hand *beneath* anterior annular ligament, and divides into two branches for thumb, one for radial side of forefinger, another for ulnar side of forefinger and radial side of middle, and a third for corresponding sides of middle and ring

fingers; this nerve gives off an interosseous and several muscular branches, the superficial, palmar, and the terminating ones.

489. The *nutritious arteries* of the bones of forearm are irregular in their origin, but always run *upwards* to the elbow-joint; that of the arm passes *downwards* to same joint.

490. In wounds of these arteries it is especially necessary to apply two ligatures (139), as the anastomoses are so numerous.

491. In amputation at the forearm pressure is to be applied on the brachial artery; both the *circular* and *flap operations* are practised here; the arteries which generally require ligatures are the radial, ulnar, and two interosseous.

CHAPTER XVIII.

THE LOWER EXTREMITY—THE HIP AND THIGH.

492. THE *six direct rotators*, outwards of the thigh, are—1st, the *pyriformis*, extended from anterior surface of sacrum to digital fossa; 2nd, the *gemellus superior*, from spine of ischium to digital fossa; 3rd, the *obturator internus*, from internal surface of obturator foramen and margin of bone around, to digital fossa: 4th, the *gemellus inferior*, from upper part of tuberosity of ischium

to digital fossa; 5th, the *obturator externus*, from outer surface of obturator foramen and margin of bone around, to digital fossa; 6th, the *quadratus femoris*, from external border of tuber ischii, to lower half of line leading from great trochanter to linea aspera, called linea quadrata.

493. The *six muscles* which *assist* in *rotation* outwards, but perform other actions also, are—1st, *psoas magnus*, from sides of bodies of last dorsal and four first lumbar vertebræ, to lesser trochanter; 2nd, the *iliacus internus*, from iliac fossa to lesser trochanter; 3rd, *pectineus*, from linea ilio-pectinea, to line leading from lesser trochanter to linea aspera; 4th, *adductor brevis*; 5th, *adductor longus*; 6th, *adductor magnus*.

494. The *pyriformis* is of a pyriform shape, and passes through the great sciatic notch; the *obturator internus* through the lesser sciatic notch, with pudic artery; the *obturator externus* runs in a groove, between acetabulum and tuber ischii; the great sciatic nerve binds down all the direct rotators outwards, except the first.

495. The *six flexors of the thigh* are—1st, the *psoas magnus*; 2nd, the *iliacus internus*; 3rd, the *pectineus*; 4th, the *tensor vaginæ femoris*, from immediately above the anterior superior spine of ilium to fascia of thigh, about four or five inches down; 5th, the *sartorius*; 6th, the *rectus femoris*.

496. The *six adductors* are—1st, the *adductor brevis*, from body and ramus of pubes to upper

third of linea aspera; 2nd, *adductor longus,* fro angle of pubes to middle third of linea asper 3rd, *adductor magnus,* from descending ramus pubes, ramus and tuberosity of ischium, to wh length of internal margin of linea aspera, exten ing from insertion of gluteus maximus to intern condyle; 4th, *gracilis,* from lower half of sy physis and ramus of pubes, to inner side of tu rosity of tibia; 5th, *sartorius,* from immediat beneath anterior superior spinous process of iliu to inner side of tuberosity of tibia; 6th, *p tineus.*

497. The *six extensors* are—1st, the *glute maximus,* from posterior fifth of crest of iliu and space beneath, from whole of spinous proces of sacrum and coccyx, and from the great sac sciatic ligament, to the rough surface below t great trochanter, and in the line extending to lin aspera; 2nd, the *gluteus medius,* from the spa or dorsum of ilium between crest and superi semicircular line, extending from notch *in fro* to gluteus maximus *behind,* and from fascia, be inserted into the external and posterior surfa of great trochanter; 3rd, *gluteus minimus,* fro space between the superior and inferior curv lines, to upper and anterior part of great tr chanter; 4th, *biceps flexor cruris,* from upp part of tuber ischii to head of fibula; 5th, *sem tendinosus,* from same origin to inner side of tub *rosity* of tibia; 6th, *semi-membranosus,* from tub *ischii,* in front of the common origin of the tw

preceding, to head of tibia, outer condyle of femur, and deep fascia at back of leg.

498. The *three abductors* are the glutei muscles.

499. The rotators inwards are, the anterior fibres of the gluteus medius and the tensor vaginæ femoris.

500. The muscle extending from *lumbar* region to *thigh* is the psoas magnus, which resembles the biceps flexor cubiti in flexing, and at the same time rotating the limb.

501. For muscles in contact with capsule, see 115. The *muscles* which *extend* from the *pelvis* to the *thigh* are sixteen in number—viz., iliacus internus, pectineus, tensor vaginæ femoris, six direct rotators, triceps adductor, semi-membranosus, three glutei.

502. The *six muscles* extending from *pelvis* to *leg* are, sartorius, gracilis, rectus femoris, biceps lexor cruris, semi-tendinosus, semi-membranosus.

503. The *four extensors* of the leg are—1st, he *rectus femoris ;* 2nd, the *crureus,* from ante- or and outer surface of femur, commencing below iterior inter-trochanteric line, to patella; 3rd, *stus internus,* from inner side of femur, extend- g from anterior inter-trochanteric line along linea era, as far as inner condyle, to be inserted into er side of patella; 4th, *vastus externus,* from er side of femur and outer margin of linea ra, as high as base of great trochanter, to the r side of patella.

4. The *eight flexors of the leg* are—1st,

biceps flexor cruris; 2nd, *semi-tendinosus*; 3rd, *semi-membranosus*; 4th, *gracilis*; 5th, *sartorius*; 6th, *gastrocnemius*, from two condyles of femur to ridge on posterior surface of os calcis; 7th, *plantaris*, from outer condyle, passes between gastrocnemius and soleus to inner side of insertion of preceding; 8th, *popliteus*, from a depression on condyle beneath external lateral ligament of knee-joint, to the triangular surface above the oblique line on tibia.

505. The *muscles* attached to femur are twenty-three in number—viz., *gluteus minimus* to great trochanter or summit; *gluteus medius* to posterior part of same process; *gluteus maximus* to rough surface behind and below same process; *five* of the *direct rotators* to digital fossa; *quadratus femoris* to linea quadrata; *psoas* and *iliacus* to lesser trochanter; *pectineus* to line beneath it; *vastus internus*, *crureus*, and *vastus externus*, round the shaft from internal brim to external brim of linea aspera; *adductor brevis* to upper third of inner margin of linea aspera; *adductor longus* to middle third, and *adductor magnus* to whole length of same line; *biceps*, from lower half of outer margin of same line; *semi-membranosus* to outer condyle; *gastrocnemius*, *plantaris*, and *popliteus*, from outer condyle.

506. The *muscles attached* to pelvis are seventy-three in number—viz., from the margin, *two* obliqui externi, two obliqui interni, two transversales abdominis, two latissimi dorsi, two quad-

rati lumborum, two gemelli superiores and two inferiores; six hamstring muscles, two quadrati femoris, six adductors, two transversales perinæi, two erectores penis, and two compressores urethræ; two graciles, two pectinei, two psoæ parvi, two recti femoris, two sartorii, two tensores vaginæ femoris, two recti abdominis, two pyramidales, one sphincter ani, two coccygei; from the surfaces, two iliaci interni, two levatores ani, two obturatores interni, two glutei maximi, two medii, and two minimi; two obturatores externi, two pyriformes, two sacro-lumbales, and two longissimi dorsi. For parts passing beneath Poupart's ligament, see 290; for saphenic opening, 291.

507. *Femoral artery* extends from Poupart's ligament to lower third of femur, where it perforates the abductor magnus to enter the popliteal space; a line drawn from *midway* between symphysis pubis and anterior superior spine of ilium to *inner edge of patella*, whilst the limb is *straight*, or to *inner head of tibia*, when the limb is *bent*, indicates its course; *it lies successively on the psoas magnus, pectineus, adductor brevis,* from which it is separated by branches of profunda rtery, *adductor longus,* and *adductor magnus;* it as to its *inner* side *above*, the femoral vein; in e *middle third* it has the saphenic nerve to its ter side, and the vein behind; in the *upper half* its course it has in front fascia cribriformis 1); in *the middle* it lies in a sheath formed by rolongation from vastus internus to adductor

longus, and has *in front* the sartorius muscle; in the *upper third* of the thigh it is found lying in a *triangular space* formed above by Poupart's ligament, on the outer side by sartorius muscle, and on inner by upper border of adductor longus muscle; from the middle of Poupart's ligament to the apex of this space runs the artery.

508. The *branches* are—(*a*) *superficial epigastric,* which pierces the cribriform fascia, passes over Poupart's ligament towards umbilicus, to anastomose with internal mammary and epigastric; this artery is always divided in the operation for hernia; (*b*) *superficial pudics,* two or more in number, piercing cribriform fascia, and going to integuments of penis and scrotum; (*c*) *superficial circumflexa ilii,* piercing cribriform fascia, passes up towards crest of ilium, supplying fascia and integuments; (*d*) *profunda femoris,* a large artery given off two inches below Poupart's ligament, which passes downwards and backwards till it arrives at the space between adductor longus i front and adductor brevis behind, where it divide into its terminal branches, to anastomose with pop liteal; it gives off the *external circumflex,* whic divides into ascending branches to supply t gluteal muscles and anastomose with gluteal a circumflexa ilii arteries, circular to anastom round the bone between quadratus femoris adductor magnus with internal circumflex, desce ing branches towards the knee-joint; *the inter ircumflex,* which passes deeply backwards betw

pectineus and psoas muscle, sends a branch to hip-joint, divides into numerous others for the supply of the muscles, and anastomoses with obturator, sciatic, external circumflex, and perforating arteries; the *other branches* of the profunda are the *three perforating* arteries; the *first* passes above adductor brevis, the *second* passes through it, and the *third* passes beneath it; they all perforate the adductor magnus, and anastomose with sciatic, gluteal, obturator, and circumflex arteries above, and arteries of knee-joint below; (*e*) *muscular branches;* (*f*) *anastomotica magna*, runs in the original course of artery with saphenic nerve to knee-joint, where it anastomoses with internal articular branch of popliteal.

509. The *arteries* which supply the hip-joint are the internal circumflex and obturator.

510. *Amputation* at the *hip-joint* is thus performed:—The surgeon, standing on the outside of the limb, passes a long sharp-pointed knife opposite
he apex of the great trochanter, carries it round
hat process, and brings out the point a little
elow the tuberosity of the ischium; by cutting
wnwards close to the bone, he completes the
sterior flap; then introducing the knife below
e neck of femur, he brings it out at the upper
gle of the wound, and by carrying it down-
rds along the femur, completes the internal
; he then divides the capsular and teres liga-
ts.

his is the position for the left leg, but the

surgeon must stand against the patient's bod
operate on the right limb.

M. Lisfranc is the inventor of this opera
which is performed expeditiously, and enables
surgeon to tie several arteries before making
internal flap. Mr. Liston prefers anterior
posterior flaps: he passes a knife horizon
makes the anterior flap first, removes the he
the bone from acetabulum, and then complete
posterior flap. In these operations an assi
must compress the femoral artery immedi
below Poupart's ligament: the arteries to be
will be the femoral, obturator, sciatic, gluteal
cumflex, and perforating.

511. In *circular amputation* at the *midc*
the thigh, the parts cut through would be
fascia, rectus, vastus externus, hamstring mu
great sciatic nerve, perforating arteries, add
longus and magnus muscles, profunda arter
moral artery and vein, saphenic nerves and
vastus internus, and sartorius muscles.

512. In the *flap* operation of the thigh
terior and posterior flaps should be made
performed high up, *lateral flaps* when low
and the external should be made first.

513. The *popliteal space*, situated at the
of the knee-joint, is of a diamond shape;
bounded *superficially* and *posteriorly* by the
and fascia, *anteriorly* by the posterior p
lower extremity of femur, by posterior lig
of knee-joint, by posterior part of head of

and by popliteus muscle; *laterally* and *internally above*, by semi-tendinosus and semi-membranosus muscle; *laterally* and *below*, by inner origin of gastrocnemius; *laterally* and *above*, on the *external side*, by biceps; and *laterally* and *below*, by outer origin of gastrocnemius and plantaris. Its *contents* are—cellular tissue, popliteal glands, internal and external popliteal nerves, femoral vein, and femoral artery and branches. In *dissecting* this region, the *nerve* is found most *superficial* and *external* above, most *superficial* and *internal* below; the *vein* next in order, and *close to the bone*, and *internal* to the *vein*, the popliteal artery.

514. The *popliteal artery* extends from the passage of the femoral, through the adductor magnus, to the lower border of the popliteus muscle, where it divides into the *anterior* and *posterior tibial;* its *branches* are *superior* and *inferior articular arteries* on the inner side, *superior* and *inferior articular arteries* on the outer side, *azygos*, and *sural*. The *four articular* branches anastomose round the joint with each other, with the profunda branches of femoral, and with recurrent branches of tibial; the *external* asses beneath the tendon of the biceps, the *internal* eneath the adductor magnus, the *azygos* pierces he posterior ligament and supplies the synovial embrane; the *sural* are several muscular anches to gastrocnemius, plantaris, popliteus, d soleus muscles.

515. *Aneurism* is frequent at this part from the constant motion of the joint, and occurs generally in dragoons, postboys, and persons who ride much; it may be distinguished from enlargement of glands by its *pulsation*, its *softness*, its *diminution* on pressure, its having the "*bruit de soufflet*," by the *nature* of the *pain*, and by the *œdematous* state of the leg (142.)

516. In *this disease* it was formerly the custom to tie the femoral artery in the popliteal space or in the tendinous canal before it passes *through the adductor magnus;* but the *ligature* is now always applied in the *upper third*, and the reasons are—1st, that the anastomosis is sufficient to supply the leg with blood; 2nd, that the operation is more easily performed above the sartorius; and 3rd, that there is less danger of finding the coats diseased.

517. There are three methods of applying a ligature to the iliacs—1st, *Abernethy's*, in which the incision is made from half an inch to the outside of the external ring upwards in the direction of the artery; a ligature is then applied from within outwards: in this method the artery is easily reached; the peritoneum is to be pushed upwards and to the inside. 2nd, *Sir Astley Cooper's* method is to make an incision in the direction of the fibres of the external oblique; the finger is then to be passed below the cord, when *the* artery can be felt and tied. In the latter *method* the peritoneum and bowels are not so much

in the way, but the former operation is best where the ligature is to be applied high up. 3rd. *The operation above the posterior part of crest of ilium*, which is difficult to perform, is well adapted where the common iliac requires a ligature.

518. The *anastomoses* when a ligature has been applied to the abdominal aorta or common iliac, are those *between* the internal mammary and epigastric; *between* lumbar branches and ilio-lumbar and circumflexa ilii; *between* branches of superior and inferior mesenteric, and pelvic branches of internal iliac; *between* spinal arteries and sciatic and gluteal; *between* external epigastric, circumflexa femoris, and arteries on abdominal and lumbar muscles; when a ligature is applied to the external iliac, the anastomoses are by the ilio-lumbar and circumflexa ilii, by epigastrics and internal mammary; by external pudics with internal pudics; by obturator and sciatic with gluteal, profunda, and circumflex; when the ligature is fixed *below* the point where the *profunda* is given off, by branches of that artery with popliteal.

CHAPTER XIX.

THE LOWER EXTREMITY—THE LEG AND FOOT.

519. THE muscles of the leg, twelve in number, are arranged in sets of three; thus, in front and

between the tibia and fibula, are—1st. *The tibialis anticus*, extending from upper two-thirds of tibia, head of fibula, intermuscular septum, and fascia, to inner cuneiform bone and metatarsal bone of great toe. 2nd. *Extensor digitorum longus*, from upper two-thirds of fibula, intermuscular septum, fascia, and from head of tibia to last phalanges of toes, uniting with extensor brevis and interossei muscles. 3rd. *Extensor longus pollicis*, from middle third of fibula to last phalanx of great toe.

520. The *three* muscles upon the *fibula* are —1st. *Peroneus longus*, from upper third to inner cuneiform bone and metatarsal bone of great toe, after passing behind external malleolus and along grove in cuboid. 2nd. *Peroneus brevis*, from middle third to metatarsal extremity of fifth metatarsal bone. 3rd. *Peroneus tertius*, from lower third of fibula to side of fifth metatarsal bone.

521. The *three superficial* muscles at the back of leg are—*gastrocnemius plantaris* and *soleus* by two origins from upper third of fibula and posterior surface of tibia, below oblique line.

522. The *three deep-seated* muscles which are separated from the superficial, by the deep fascia sent down from the semi-membranosus muscle, are —1st, the *flexor digitorum longus perforans*, from posterior surface of tibia below oblique line, to the third phalanges of four outer toes; 2nd, *flexor longus pollicis*, from lower two-thirds of fibula *below* soleus, and from intermuscular septum, to *last* phalanx of great toe; 3rd, *tibialis posticus*,

from posterior surface of tibia below oblique line, from posterior surface of fibula, and from interosseous ligament for two-thirds of its way down, to under surface of all the bones of tarsus *except* the *astragalus*.

523. The *four extensors* of the foot are, tibialis anticus, extensor digitorum communis, extensor longus pollicis, peroneus tertius.

524. The *four superficial flexors* of the foot are—gastrocnemius, soleus, plantaris, peroneus longus.

525. The *four deep-seated flexors* are, the flexor longus digitorum, flexor longus pollicis, peroneus brevis, and tibialis posticus.

(The functions of these muscles are reversed by some anatomists, though it is difficult to understand upon what grounds.)

526. The muscles *attached* to the *tibia* are nine in number—viz., *sartorius*, *semi-tendinosus*, *gracilis*, to inner side of head of tibia; *extensor longus digitorum*, to head; *tibialis anticus*, to anterior and upper two-thirds of external surface; *popliteus*, to triangular space at back; *flexor longus digitorum*, below oblique line at back; *soleus*, from oblique line; *tibialis posticus*, from surface of bone adjoining interosseous ligament.

527. The *muscles attached* to the *fibula* are also nine in number—viz., *biceps*, to head; *extensor longus digitorum*, to upper two-thirds of anterior surface; *peroneus longus*, to upper third of oute[illegible] surface; *peroneus brevis*, to middle third of out[illegible]

surface; *peroneus tertius*, to anterior and lower third; *extensor longus pollicis*, to middle third of anterior surface; *soleus*, to upper third of posterior surface of fibula; *flexor longus pollicis*, to lower two-thirds of posterior surface; *tibialis posticus*, to posterior surface adjoining interosseous ligament.

528. The parts passing *behind* the *internal ankle* are, *tibialis posticus*, close to internal malleolus; *flexor longus digitorum*, next in succession, and in the same groove with the preceding; a few lines external lies the *posterior tibial artery*, with a *vein* on *each side;* a quarter of an inch to the outer side of this is the *posterior tibial nerve;* and most external of all, in a groove at the posterior part of astragalus, is the tendon of *flexor longus pollicis.*

The parts passing behind the external malleolus are, the peroneus longus and brevis muscle, and the posterior peroneal vessels.

529. The parts passing in *front* of the ankle joint are, *the tibialis anticus, extensor longus digitorum, extensor longus pollicis, peroneus tertius* muscles; *anterior tibial artery* and *nerve; saphenic nerve* and *vein.*

Passing down to the foot behind the joint, besides those parts mentioned as passing behind the malleoli, are the tendons of gastrocnemius, soleus, and plantaris.

530. The *anterior tibial artery*, immediately [illegible]*ter the* bifurcation of the popliteal, passes forwards

through the interosseous space, between the two origins of tibialis posticus to anterior surface ot interosseous ligament: if a line be drawn from the head of fibula to the junction of inner with outer two-thirds of space between internal and external malleolus in front, it will give the exact course of this artery; in the upper part it lies between tibialis anticus and extensor digitorum longus; lower down, between tibialis anticus and extensor longus pollicis; and just above the ankle-joint, the extensor longus pollicis tendon crosses it; below which point it lies between extensor longus pollicis and extensor longus digitorum; it has venæ comites accompanying it, and to its outer side lies the anterior tibial nerve, which last becomes superficial in the lower part of the leg; on the foot it passes between the extensor tendon of the great toe and the extensors of the other toes, as far as the space between the first and second metatarsal bones, where it divides into its terminating arteries.

531. The *branches* are—(*a*) the recurrent, which passes upwards and anastomoses with articular; (*b*) muscular; (*c*) malleolar, to the internal and external ankle; (*d*) tarsal; (*e*) metatarsal; (*f*) dorsalis pollicis, which divides and supplies the adjacent sides of the great and the second toes; (*g*) communicans, to anastomose, through interosseous space, with terminating branch of external plantar.

532. The *posterior tibial* artery, larger than the

preceding, extends from border of popliteus muscle to inner malleolus, lying obliquely from the middle of leg to middle of space between heel and inner ankle; it is accompanied by two veins and by the posterior tibial nerve, which lies to its inner side above, but after soon crossing it, lies to its outer side as far down as the foot; it is placed first on tibialis posticus, then upon flexor longus digitorum, and afterwards upon fat and cellular tissue, which alone separate it from the bone. For relative situation behind the inner ankle (see 528): superficial to the artery are gastrocnemius, soleus, and plantaris muscles, and deep fascia.

533. To *tie the posterior tibial* at the upper part, an incision may be made along the inner edge of the tibia four or five inches in length; then by dividing the origin of soleus and the deep fascia, it may be found without much difficulty. *Another plan* is, to *cut* through the *gastrocnemius* and *soleus* in the course of the artery.

534. The *branches* are—(*a*) peroneal, which descends between fibula and flexor longus pollicis, first lying on tibialis posticus and then upon fibula itself; at the lower third of leg, it divides into anterior and posterior peroneal; the ***anterior***, after piercing the interosseous ligament, runs down beneath the peroneus tertius to the instep and external malleolus; the *posterior* runs down behind the external malleolus, and anastomoses with preceding and with posterior tibial; (*b*) arteria nutritia *tibiæ;* (*c*) muscular branches.

A ligature may be applied behind the internal malleolus, by making a semilunar incision through the skin, fascia, and aponeurosis, rather nearer to the ankle than the heel, and then passing a needle from without inwards.

FOOT.

535. The plantar fascia, an extremely dense aponeurosis, is attached posteriorly to tubercle of os calcis; anteriorly it divides into *three* portions, of which the *inner* and *outer* soon terminate, by being lost on the great toe, and by being firmly attached to fifth metatarsal bone; the *middle* portion divides into *five* processes to the five toes, to be attached to the sides and the sheaths of the tendons; transverse fibres are seen strengthening it; its use is to keep the arch of the foot, to sustain the muscles and vessels, to preserve them from injury, to give origin to them, and to give elasticity in the foot.

536. The muscles are arranged in *four* layers, and are as follows:—

First layer—Flexor digitorum brevis perforatus, arising from tuberosity of os calcis, fascia, and intermuscular septa, *inserted* into sides of second phalanges of four outer toes; *abductor pollicis,* from inner side of tuberosity of os calcis, from internal annular ligament, from intermuscular septa, and from fascia, to inner side of base of first phalanx of great toe; *abductor minimi digiti,* from outer side of same bone, from external annular ligament, from septa, and from plantar fascia, to base of first phalanx of fifth toe. Between this layer and the next are seen the *plantar vessels* and the *deep plantar fascia*, binding them down.

537. *Second layer*—1. *Musculus accessorius*, or massa carnea, from under surface of os calcis to side of tendon of flexor digitorum longus; 2. *tendons of flexor digitorum longus* and *pollicis*; 3. *lumbricales*, four in number, arising from the inner side of the tendons of the flexor longus digitorum, to the extensor tendons and base of first phalanges.

538. *Third layer*—1. *Flexor brevis pollicis*, from os calcis, cuboid, and external cuneiform bone, to sides of base at first phalanx, by two tendons; 2. *adductor pollicis*, from cuboid bone, from middle and external cuneiform bone, and from third and fourth metatarsal bones, to base of first phalanx; 3. *flexor brevis minimi digiti*, from fifth metatarsal bone, and from sheath of the peroneus longus, to base of first phalanx of fifth toe.

539. *Fourth layer*—1. *Transversalis pedis*, from heads of metatarsal bones of four outer toes, to base of first phalanx of great toe; 2. *interossei*; these muscles are very similar to those in the hand in their appearance, number, and use; there are *three plantar*, which arise from tibial side of three outer metatarsal bones, to base of first phalanges of same toes, and extensor tendons; they all draw to the second toe; 3. *the tendon of the peroneus longus* running across the foot in a groove in *cuboid* bone, and the *tendon* of *tibialis posticus*.

540. The *plantar arteries* commence at the bifurcation of the posterior tibial, between the origins of the abductor pollicis. The *internal* runs along the inner border of the foot between the abductor pollicis and flexor brevis digitorum supplying these muscles, the inner border of the foot, great toe, and inner half of second; the *external plantar*, much larger than the preceding, passes from the bifurcation to the base of fifth metatarsal bone, lying between the first and second layer of muscles; it then turns towards the inner side of the foot, and runs between the second and third layer to the first metatarsal space, where it anastomoses with the communicating branch of the anterior tibial; it gives off (*a*) *muscular branches*, (*b*) four *digital* ones to the three outer toes, and outer side of the second, (*c*) *perforating*, which, at each bifurcation of the toes, anastomose with interosseous from anterior tibial; (*d*) *posterior perforating branches*, which pass between the two origins of dorsal interossei to anastomose with metatarsal.

541. *Posterior tibial nerve divides into internal* and *external* plantar, of which the *internal* is the larger. This last nerve accompanies the internal plantar artery, and divides into branches to supply the three inner toes, and one side of the fourth; the *external plantar* accompanies the external plantar artery, gives muscular branches to the sole of foot, to the outer border, to the little toe, and one-half of the next.

542. *Peroneal nerve*, one of the divisions of the

popliteal, descends by the side of the tendon of biceps, winds round the neck of the fibula, pierces the peroneus longus, and divides into (*a*) anterior tibial, (*b*) musculo-cutaneous; (*a*) *anterior tibial* passes beneath the extensor digitorum, to reach the anterior tibial artery, on the outer side of which it courses down the leg, afterwards getting to the front; near the ankle it passes to the outer side of artery again, then under annular ligament to dorsum of foot, which it supplies, sending branches to the adjoining sides of great and second toe; (*b*) *musculo-cutaneous* passes between peroneus longus and extensór digitorum communis to lower third, where it pierces the fascia, and divides into two cutaneous branches, which pass in front of the joint, supplying the integuments of the foot and toes.

The *external saphena nerve* is formed by a branch called communicans tibiæ, given off from posterior tibial, joining a branch from peroneal, from which union the external saphenic nerve passes superficially behind external ankle on to dorsum of foot, which it supplies.

543. The extensor digitorum brevis muscle, placed on the dorsum of foot, extends from os calcis to extensor tendons of second, third, and fourth toes, and to base of first phalanx of great toe.

544. The dorsal interossei arise by two origins *from* adjacent metatarsal bones, and are inserted *into* sides of base of first phalanx; the second,

or the longest toe, has one on each side, and there is one on outer side of third, and on outer side of fourth toe; these muscles all draw away from the longest toe, exactly the same as in the hand.

545. In *amputating* the leg, the posterior or larger flap must be made first; the arteries requiring ligatures are, anterior and posterior tibial and peroneal.

546. The muscles attached to os calcis are, gastrocnemius, plantaris, soleus, extensor digitorum, brevis, flexor digitorum brevis, abductor pollicis, abductor minimi digiti, musculus accessorius, and flexor brevis pollicis.

547. The muscles attached to internal cuneiform bone are, tibialis anticus, peroneus longus, and tibialis posticus.

548. Those attached to fifth metatarsal bone are, peroneus brevis, and tertius, dorsal and plantar interossei, and transversalis pedis.

549. Rupture of the tendo Achillis, or the combined tendon of gastrocnemius, soleus, and plantaris, sometimes occurs; the accident happens suddenly, is attended with a loud snapping noise, and is known by the tumour felt on the calf, by the depression, and by the loss of power of extension of the foot.

Treatment.—A slipper with an elastic strap attached to the heel and fastened round the calf, keeping the leg flexed, and thus tending to approximate the ruptured tendon.

550. The *four extensors* of the toes are, extensor

longus pollicis, extensor longus digitorum, extensor brevis digitorum, and interossei.

The *four flexors* are, flexor brevis digitorum, flexor longus pollicis, flexor brevis pollicis, and musculus accessorius.

CHAPTER XX.

ON THE EYE.

For bones of orbit, see 40. For appendages, 160.

551. The *globe* is formed by segments of two different sized spheres, of which the posterior is largest, and constitutes four-fifths; the *axis of the globe* of one side corresponds to that of the other, but not to that of the orbit, hence the optic nerve enters the globe to the inner side of axis of eye. The membranes or tunics are, the conjunctiva, the cornea, the sclerotic, tunica albuginea, the choroid, the retina, the iris, the hyaloid, the capsules of the crystalline lens, and of the aqueous humours. The *humours* are, the vitreous, the aqueous, and the crystalline lens.

552. The *conjunctiva* is a mucous membrane, and is continuous at the puncta lachrymalia with the mucous membrane of the nose and nasal ducts; it is continuous at the margin of eyelids with skin, and is reflected over the anterior third of globe, *covering* cornea and lining eyelids; at its upper *and outer* part, open the ducts of lachrymal gland.

553. The *sclerotic* is a fibrous membrane derived from the dura mater, which covers the optic nerve (388); it is thickest posteriorly, and is strengthened anteriorly by the expansion of the tendons of recti muscles, called *tunica albuginea,* which is interposed between it and the conjunctiva.

554. The *cornea,* which occupies the anterior fifth of the globe, is arranged in laminæ, and is connected to the anterior border of sclerotic very firmly.

555. The *choroid* is vascular, and consists of two layers; the *outer,* composed of veins arranged in arches, which are called *venæ vorticosæ,* is *connected* to the ciliary ligament. The *inner,* composed of ramifications of the short ciliary arteries, is called *tunica Ruyschiana;* the *villous appearance* on the inner surface is called *tapetum,* and appears to secrete the *pigmentum nigrum;* between the sclerotic and the choroid run the *long ciliary arteries* and the *ciliary nerves;* this membrane is pierced by the optic nerve.

556. The *retina* consists of three layers: 1. The internal or *fibrous* layer is continuous with the optic nerve (the fibrillæ of which here lose their white substance of Schwann), and has also numerous ganglionic cells and nuclei developed in it. 2. The middle or *granular* layer consists of oval bodies collected into two sets, between which is granular material. 3. The outer layer, or *Jacob's* membrane, consists of a peculiar arrange-

ment of particles to which the names of *rods* and *bulbs* have been given; these rods are continuous with some fibres which pierce the whole depth of the retina (fibres of Müller).

In the axis of the eyeball is the yellow spot (*macula lutea*). The entrance of the optic nerve is about $\frac{1}{10}$ of an inch to the inner side of the axis.

557. The *hyaloid membrane* surrounds the vitreous humour, and is continuous anteriorly with the membrane of the lens.

558. The *ciliary ligament*, about a line and a half in breadth, is attached to the inner surface of the sclerotica, at its junction with the cornea; *posteriorly* it is connected with the choroid, *anteriorly* with the lens; on its *outer side* is a small canal called *ciliary canal.*

559. The *ciliary processes* are from sixty to eighty triangular processes, apparently *folds* of the *choroid;* one side of them is opposed to the iris—the posterior to the lens and vitreous humour, the internal is free. The aggregate of these processes is called *corpus ciliare.*

560. The *iris* is the vascular curtain which separates the anterior and posterior chambers, and is composed of involuntary muscular fibres, *radiating* and *circular;* the posterior surface is covered with dark pigment, called *uvea;* the *long* and short ciliary arteries and ciliary nerves *(553)* terminate in it; the *veins* either accompany the arteries, or terminate in the venæ *vorticosæ*

which empty themselves *into the ophthalmic.* The pigment is wanting in albinos.

561. The *membrana pupillaris* is a vascular membrane which closes the pupil or central opening in the iris in the fœtus, but which becomes obliterated shortly before birth.

562. In *front* of the iris, and behind the lens, is the *anterior chamber,* lined by a membrane which is continuous with that lining the *posterior chamber,* placed between the iris and lens.

563. The *crystalline lens* is a bi-convex body; its *posterior* surface, which is most convex, is embedded in the vitreous humour; its *anterior* looks towards the posterior chamber; it is enclosed in a capsule, which at the margin unites with the hyaloid, and leaves a canal extending all round the lens, called *canal of Petit;* between the lens and its membrane is a small quantity of fluid called "*liquor Morgagni.*" The structure is complicated, consisting of fibres arranged round three axes running in different directions.

564. The *vitreous humour* occupies the posterior two-thirds of the globe of the eye, and lies in *cells* formed by processes of hyaloid membrane sent inwards, but which communicate together; at the *anterior* part is a depression extending round the lens, and lodging the ciliary processes called "*zonula of Zinn.*"

For arteries of eye, see 607.

565. The rays of light which pass from any point on the convex cornea are refracted towards

the perpendicular upon the iris; the portions of them which fall on that muscular body are reflected; those in the centre traverse the pupil, and arriving at the convex lens are again refracted towards the perpendicular; passing from the posterior convex surface into a less dense medium, they are refracted *from* the perpendicular, and fall upon the retina in one single point; it will be seen that those rays which come from the superior part of an object impinge on the lower part of retina, those from the lower on the upper part; but as the vision is in the direction of the ray, the object is beheld in its proper position and place.

The *adjustment* or *accommodation* of the eye is thus explained:—The lens, which is very elastic, is kept in a state of tension by its suspensory ligament; if the ciliary muscle contracts it will relax that ligament, and thus diminish its tension on the lens. The lens therefore becomes more convex, returning to its former shape when the ciliary muscle ceases to contract, and allows the choroid to return to its ordinary place.

566. *Myopia,* or short-sightedness, depends upon the too great convexity of the cornea or lens refracting the rays of light too much, and thus bringing them to a focus before they reach the retina.

567. *Presbyopia* arises from the convexity of the lens and cornea not being sufficient to bring the rays to a focus till after they have passed the retina.

568. *Strabismus,* or squinting, depends upon

the too powerful or spasmodic action of one of the recti muscles, from paralysis of some. of them, or contraction of their tendons.

The operation for its cure consists in *dividing* the tendon of the muscle, which, from its too powerful action, draws the eye from its *axis of vision.*

569. To detect *foreign bodies* in the conjunctiva, the upper eyelid must be everted by placing a probe upon its outside, and by taking hold of the *eyelid* with the other hand, and drawing it *over* the probe. The lower lid may be everted in a similar way; if this does not succeed, the eye must be syringed, and the object left, till detached by *ulceration.* In trifling cases, the mere placing of the upper lid over the lower is sufficient to remove the substance.

570. *Acute ophthalmia* is known by the redness and turgid state of the membrane, by pain, intolerance of light, sensation of something gritty, diminution of the tears when the inflammation is very high, and sympathetic fever; sometimes *lymph* or *serum* is effused beneath the conjunctiva as far as the edge of the cornea, which thus appears depressed, constituting chemosis.

The *causes* are—cold, foreign bodies in the eye, extension of the inflammation from other parts, or specific causes, as rubeola.

The *treatment* consists in bleeding, generally and locally, blisters, purgatives, diaphoretics, especially antimonials, lotions of lead, zinc, or alum, poultices, and occasional doses of calomel.

Chronic ophthalmia differs from the preceding principally in degree.

571. *Sclerotitis* is distinguished from the preceding by the *pink* colour of the redness; by its commencing *round the cornea,* that of conjunctivitis commencing at the *circumference* of the eye; by the vessels running in straight lines in sclerotitis, and by the bright scarlet redness of the latter.

572. *Purulent ophthalmia* commences in the membrane lining the lids, but soon *extends* to *globe of eye;* there is *swelling, great vascularity, discharge of thick yellow pus;* the conjunctiva has a *villous* appearance; there is considerable *chemosis,* and all the other symptoms of conjunctivitis.

The *acute stage* of this complaint passes quickly, and it has a great tendency to terminate in *opacity, sloughing,* or *ulceration* of the cornea.

The three kinds are, that in *new-born children,* from *vaginal discharges;* that in *adults,* from *gonorrhœa;* and the idiopathic.

Treatment.—The antiphlogistic plan must not be carried *beyond* the acute stage; after which period, *counter-irritants, nitrate of silver injections,* or *ointment,* and *tonic* remedies, are most beneficial.

573. *Strumous ophthalmia* is characterized by *great intolerance of light;* by frequent sneezing on exposure to light, by *spasmodic contraction* of the orbicularis; by the *inflamed* state of the eye

not being sufficiently severe to account for the dread of light and the pain; and by *its occurring* in a *scrofulous* individual.

Treatment.—Mild local depletion may be necessary in the first instance, but more depends on the attention to the *general health,* on tonic and sedative injections, as the vinum opii, on blisters, tonic medicines, nitrate of silver ointment, or lotion, generous diet, occasional mercurial purgatives, and sea air and bathing.

574. *Opacities of the cornea* are, 1st, *nebulæ,* which are caused by thickening, or deposit of lymph beneath conjunctiva; 2nd, *albugo,* depending upon *deposits* of *lymph* between the layers of cornea; 3rd, *leucoma,* the cicatrices from ulceration; 4th, *onyx,* a deposit of purulent matter or lymph in the form of the white of the nail, between the layers of the cornea, at its margin.

575. *Ulceration of cornea* begins with a small pustule, which *bursts* and leaves an *excavation* of an *ash colour* and irregular edges; *applications* of *nitrate of silver* are well adapted to all these forms of opacity or disease; but inflammatory remedies may be necessary in the last kind.

576. *Iritis* arises from *syphilis,* from *cold,* from *constitutional causes,* as *rheumatism, scrofula,* or *cachexia.*

There is *pain,* sometimes very great, but sometimes very trifling; *discoloration and muddy state* of the *iris; intolerance of light, irregularity* and *inaction of pupil,* sometimes *vascularity* of the *sclerotic*, and a *zone* round the cornea; *disturbance of the secretions*, *fever*, and a *hard, quick pulse*. That which arises from *syphilis* is known by its *following* or *accompanying* that *complaint;* by its becoming *worse* towards *night*, by the *reddish-brown discolorations* of the *inner circle* of the iris, and the early irregularity of the pupil; by the deposit of lymph in *nodules*. There is a definite zone of sclerotic redness. In *rheumatic* iritis there is less tendency to the deposit of lymph on the iris or anterior chamber, but the adhesion is more general, and the pink sclerotic zone is not so well marked.

Treatment.—Local *bleeding*, and the *administration of mercury* in the form of hyd. cum cretâ combined with hyoscyamus, to cause absorption, or prevent effusion of lymph, and applications of belladonna to prevent contraction of iris to capsule of lens.

577. *Amaurosis* is a loss or impairment of vision from some change of optic nerve, retina, or brain, and the term is confined to cases in which the nervous element is involved; caused either by *disease in those parts*, as embolism of the art. centralis retinæ, by *disease in the brain*, or by *affections* of the *general health;* the pupil is generally dilated and motionless, the iris is nearly immovable, and vision is lost; frequently, also, there is strabismus, and usually great brightness of the eye.

578. *Glaucoma* is choroiditis (or irido-choroi-

ditis) with diffuse imbibition by the vitreous body (and aqueous humour), in which increase of the intra-ocular pressure, compression of the retina, &c., are produced by the increased volume of the vitreous humour (Von Graefe).

There is great distension of the eyeball, intense pain, rapid loss of sight, and a gradual involvement of every tissue of the globe.

Iridectomy appears to afford good results in many cases.

579. *Cataracts* are of four kinds—1st, *hard;* 2nd, *soft* or *caseous;* 3rd, *congenital;* 4th, *capsular.*

1st, *In hard cataract* the lens is *smaller* than natural, *more convex,* of *a straw or amber colour,* and occurs in *advanced age;* 2nd, *soft* or *caseous:* it is of *milky-white colour, increased in size,* and the *spots* or *streaks* are *fixed;* 3rd, *congenital* is always of the soft kind; 4th, *in capsular* the *lens* is not quite *opaque,* and the *opacity* is more or less *deep-seated,* from its being upon the *anterior* or *posterior part of the capsule;* the *colour* is *pearly-white,* and *striæ* are seen extending across.

580. *Capsulo-lenticular;* very common; both capsule and lens involved.

Hard cataracts are known by their colour, by their great convexity, and by the patient having some degree of vision when the pupil is much dilated.

The *causes* are, injury, operations, or hereditary tendency.

Treatment.—1, *Breaking up* of the lens, or *solution;* and 2, *extraction:* in the first the needle is inserted posterior to the iris; in extraction, the knife is passed in anterior to it, and one half of the cornea is divided.

581. *Diagnosis* between *cataract* and *amaurosis;* in the former, the opacity is *behind* the iris; in the latter, *no opacity* is seen, or it is of a muddy colour; in the former, the iris *acts freely;* in the latter, it is *immovably dilated;* in the former, vision is better in a *dull light;* in the latter it is better in a *strong one;* the former comes on *gradually,* and is *unaccompanied* with *disturbance* of the general health; in the latter, there is *previous disease;* in the former, there is no apparent *alteration of appearance* in the aspect of the eye; in the latter, there is a *vacant stare;* the two diseases, however, may be complicated.

The ophthalmoscope is the greatest aid to diagnosis, and the essential changes shown in amaurosis by this instrument, are atrophy of the nervous apparatus, and shrinking of the blood-vessels.

582. *Extraction of cataract* is more adapted to the firm kind; *solution* to the soft and that of children.

Entropium, or inversion of the eyelids, is produced from ulceration of the tarsi; *ectropium,* or *eversion,* happens from ulceration on their edges, or from cicatrices, most usually of burns.

583. *Ptosis*, or falling of the lid, depends upon paralysis of the third nerve.

584. *Encanthis* is an enlargement of the caruncula, which prevents the lids closing.

585. *Pterygium*, which is either membranous or vascular, consists in the extension of an ash-coloured triangular membrane or of arteries over the cornea: the former must be dissected off, the other may be scarified.

586. *Staphyloma* is an unusual projection of the cornea, and is attended with partial or *total loss of vision.*

587. *Hydrophthalmia*, or dropsy of the eye, arises precisely as in other cavities, and depends on same causes. Iridectomy useful in this disease.

588. *Closure of the pupil* from disease, requires a section of the iris, when the natural elasticity causes it to retract, and thus forms an artificial pupil.

589. *Hypopium* is the collection of pus or lymph in the anterior chamber.

590. *Epiphora*, an over-secretion of tears, is produced by inflammation, or any mechanical irritation, or may be caused by an obstruction in one or both lachrymal canals or nasal duct. (*Stillicidium lachrymarum.*)

591. *Hordeolum*, or *stye*, consists of a small abscess at the margin of the lid, and is caused by *obstruction* in one of the *Meibomian follicles;* it may be produced by any external irritation, but in general results from derangement of the digestive

organs. *Treatment.*—Poultices or fomentations and ointments which are slightly stimulating.

592. *Fungus Hæmatodes* proceeds from the bottom of the eye to the cornea, and is liable, in the first instance, to be *mistaken* for a *cataract*, but may be known by the ramifications of the arteria centralis retinæ on it; as it increases in size it assumes a dark purple hue, and after protruding either at the cornea or the conjunctiva, bleeds and sloughs; *early extirpation of the eye* is the only mode of treatment.

593. Extirpation of the eye is performed by placing the patient in a chair, and then passing a needle armed with a ligature through the globe, and afterwards dividing the conjunctiva, muscles, and optic-nerve. The lachrymal gland should be removed.

594. *Fistula lachrymalis* is caused by an obstruction in the nasal duct; followed by suppuration; the abscess bursting causes the fistulous aperture. The symptoms are epiphora or watering of the eye, dryness of corresponding side of nose, and colourless swelling over lachrymal sac. In the early stage leeches and fomentations may remove this disease, but in the more advanced it will be necessary to slit up the canaliculus, upon a fine director, and to introduce into the sac a series of probes of increasing size, by which dilatation is gradually effected.

594 bis. The fundus of the healthy eye, as seen *through* an ophthalmoscope, shows *the arteries* *and veins radiating on the retina* (the latter being darker and larger). The *optic disc*, which is circular, of a bright white colour, and perforated by vessels in its centre. The *macula lutea*, which lies directly in the axis of vision, is recognised by the *absence* of retinal vessels.

CHAPTER XXI.

MISCELLANEOUS.

EAR.

595. THE *organ of hearing* is divided into—1st, *external*; 2nd, *middle*; and 3rd, *internal ear*.

1st. The *external* consists of the auditory canal and the pinna; the *former* describes a curve of which the *convexity* is upwards; its anterior wall is the longest, consequently the membrane which is stretched across at the bottom of the canal looks downwards, outwards, and forwards; the *pinna* is *fibre cartilage*; its *posterior* margin is called *helix*, *within* which is the *antihelix*: *in front* of the opening is a prominence called *tragus*, and behind, a smaller one, called *antitragus*; at the *upper part*, between the branches of the antihelix, is the *scaphoid fossa*, and between the helix and the antihelix is the *fossa innominata*; the *concha* is the enlarged commencement of the meatus.

596. The *muscles* moving these
major and *minor helicis ;* the *tragi*
tragicus.

597. The skin is continued into
and is reflected over the *membrana t*
canal is plentifully supplied with
secrete wax, and with some bulbs of

598. 2nd. The *middle ear* consis
panum, a bony cavity, bounded *exte*
membrana tympani, internally by th
fenestra ovalis, fenestra rotunda, a
behind, by the *mastoid cells ; infer*
Glasserian fissure, the openings of th
tube, and that for the *tensor tymp*
process of bone called *processus co*
which separates them ; mucous mem
tinued up the Eustachian tubes, line
and forms one of the layers of the m
pani ; interposed, between this and
fibrous membrane, the junction
membranes forms the *membrana t*

599. The *tympanum* contains
placed against the fenestra ovalis
tached to the stapes ; the *malleu*
cessus gracilis and its *manubri*
orbiculare, attached to the lon
incus. The stapedius muscle i
neck of the stapes bone : the ten
handle of the malleus ; the laxa
passes through the Glasserian
process ; its openings are eight

an tube; 2nd, the *Glasserian fissure,* through ich pass the chorda tympani nerve and laxator pani muscle (39); 3rd, the *mastoid cells;* 4th, *ning* on pyramid; 5th, *fenestra ovalis;* 6th, *estra rotunda;* 7th, *meatus auditorius,* and ning for entrance of chorda tympani, called *men chordæ;* 8th, entrance of tensor tym- i.

00. 3rd. The *internal ear,* or *labyrinth,* con- s of the *cochlea,* the *semicircular canals;* and vestibule.

01. The *vestibule* is situated *in front* of the icircular canals, and *behind* the cochlea; the *nings* into it are—1st, The entrance of portio lis through meatus auditorius internus by *four ive minute holes;* 2nd, the *opening* of the *scala ibuli* of the cochlea; 3rd, the *five orifices of semicircular canals;* 4th, the *fenestra ovalis;* , the *aqueductus vestibuli* for a vein.

02. The *cochlea* is of a *conical* shape, placed its base to the vestibule: it consists of a tube ning up the centre, called the *modiolus,* round ch a spiral canal, divided into two parts, called *æ,* by a plate of bone, twists *twice* and *a half;* he base they diverge; one of them, called *scala ibuli,* opens into the vestibule, the other, *scala pani,* into the fenestra rotunda; the *aqueductus leæ,* commencing near the termination of scala pani, transmits a vein to jugular fossa; between scala tympani and scala vestibuli is the *scala ia,* in which are the rods of Corti.

603. The *semicircular canals* are three in number, which open into the vestibule by five openings only, as the *superior* or *vertical*, and the *posterior*, or *oblique*, join before terminating; there is a prominence on the petrous portion of temporal bone which marks the *situation* of the *superior one* (38); these *cavities* are lined by a delicate membrane upon which is an expansion of *portio mollis*. The membranous labyrinth contains a fluid called *endolymph*, and between it and the bony labyrinth is the *perilymph*.

604. The *meatus auditorius internus* terminates by several openings; through the *upper* passes the *portio dura*, which is continued along the Fallopian aqueduct with the superior petrosal nerve; *the others* give passage to the *portio mollis*.

605. *Foreign bodies* in the *ear* must not be removed with a probe, but by syringing the meatus, or *very cautiously* using a pair of forceps. The same plan will remove insects, or sweet oil may be dropped in.

Inflammation and ulceration of the ear must be treated actively, as the parts in the tympanum are rapidly destroyed by *ulceration* and *sloughing*.

THE INTERNAL CAROTID ARTERY.

606. After passing through the carotid canal in the petrous portion of the temporal bone, this artery *crosses* the *foramen lacerum medius* to the side of the *sella turcica*, opposite anterior clinoid pro-

cess, pierces the dura mater, and divides into its terminating branches.

In the neck it lies to the *outside* of the *tonsil* upon the *rectus capitis anticus* muscle, and separated from the external carotid by the *stylo-pharyngeus* and *stylo-glossus* muscles and by the *glosso-pharyngeal* nerve (187); *higher up* it lies *behind* the *parotid gland,* and then enters the bone.

607. *Its branches* are—1st, *tympanic;* 2nd, *anterior meningeal,* distributed to the dura mater; 3rd, *ophthalmic,* which enters the orbit through the foramen opticum to the outer side of optic nerve, runs along inner wall of orbit, and divides into a frontal and a nasal branch, giving off (*a*) lachrymal to the lachrymal gland; (*b*) supra-orbital accompanying the frontal nerve to forehead; (*c*) posterior and anterior ethmoidal passing through the ethmoidal foramina and supplying ethmoidal fossæ and cells; (*d*) nasal to nose and angle of eye, inosculating with angular artery; (*e*) palpebral to eyelids; (*f*) frontal to forehead; (*g*) muscular; (*h*) the long and short ciliary; (*i*) centralis retinæ; (*j*) *anterior cerebral,* which passes up between hemispheres of brain to upper surface of corpus callosum, and anastomoses with posterior cerebral; (*k*) *middle cerebral,* passing along the fissure of Sylvius; (*l*) posterior communicating, anastomosing with posterior cerebral of basilar.

VERTEBRAL ARTERY (188).

608. After passing through foramen magnum, unites with the *opposite* artery at *lower border* of *pons Varolii* to form *basilar*, which runs forward on this body, and at anterior border of same body divides into its terminating branches.

609. *Branches of Vertebral* are—1st, *lateral*, 2nd, *posterior*, and 3rd, *anterior spinal*; 4th, *posterior meningeal* to the dura mater; 5th, *inferior cerebellar* along upper part of medulla oblongata to under surface of cerebellum.

610. The branches of basilar are—1st, *transverse*, to pons Varolii; 2nd, *superior cerebellar* to upper surface of cerebellum; 3rd, *posterior cerebral* to posterior lobes of cerebrum; 4th, *auditory* to internal ear.

611. The *circle* of *Willis* is formed by the posterior communicating, uniting the internal carotid to the posterior cerebral *on each side*; by the bifurcation of the basilar into posterior cerebral *behind*; and by the anterior communicating, uniting the two anterior cerebrals *in front*.

612. Enclosed in this space are, the *locus perforatus posticus*; *corpora albicantia*; *tuber cinereum*; *locus perforatus anticus*, *optic commissure*, *infundibulum*, and origin of *third nerve*.

THE SKIN.

613. This tissue consists of *three* layers—1st, *the epidermis* or cuticle, composed of several

layers of epithelial cells of the squamous kind; 2nd, *the rete mucosum,* a secretion from the vessels of the true skin between the other two layers, differing in colour in different nations, and absent in some; 3rd, *cutis vera,* which is continuous with the mucous membranes lining the cavities; it is formed of filamentous tissue, the cells in which are largest at the inner surface, but become so close at the outer as to be called "textus papillaris."

In this *papillary structure* the nerves terminate in, and are surrounded by, a delicate vascular structure: it is also in this structure that are found the sebaceous glands, the roots of the hairs, and the terminations of the vessels.

614. The *hairs* are *horny filaments,* consisting of a *stem* and a *root; the former* is unattached, and terminates in a point; the latter is destitute of colour, and is implanted in the papilla; they are *tubular,* but not quite cylindrical, and are filled with an *oily fluid,* which differs in colour in different persons.

615. *Absorption* takes place at all parts of the body, both externally and internally, but is much less active on the external surface than in the cavities; the removal of the cuticle favours external absorption. Besides absorption, from *surfaces* both internal and external, *this process* is constantly carried on in the *solids.* Absorbents differ from blood-vessels in their tortuous course, small size, and frequent communication.

When *injected* with *mercury* they appear to cover the whole surface of the body, and to form a *complete network.*

616. Blood when circulating is composed of a nearly colourless transparent liquid, the *liquor sanguinis,* in which numerous disc-shaped corpuscles float; these form about 130 parts in every 1000, and are of two kinds; the red, to which the colour of the blood is due, are about $\frac{1}{3200}$ of an inch in diameter, and the white about $\frac{1}{2500}$ of an inch in diameter.

When blood is allowed to rest it soon coagulates, and separates into two portions, the clot or crassamentum and the serum; the former, more or less firm, consists of fibrin, in which are contained the red and white globules; the latter is fluid. The serum consists of water, albumen, salts of potash and soda, and animal matter. The crassamentum consists of fibrin, albumen, and colouring matter, containing iron.

617. *Perspiration* contains lactic acid, osmazome, salts of soda and potash, with mucus.

618. *Mucus* is soluble in acids, pus is not; mucus does not coagulate with heat, pus does.

619. The *Tongue* is composed of *intrinsic* muscles (lingualis superior, lingualis transversus, lingualis inferior), constituting the body of the tongue, and containing also erectile tissue, covered by a reflection of the mucous membrane of the *mouth,* which forms a fold beneath and in front, called *frænum linguæ*; and *behind,* where it is

situated near the os hyoides, *another*, called *frænum epiglottidis;* and the *extrinsic* muscles which are connected with it are the *palato-glossus;* the *hyo-glossus;* the *genio hyo-glossus;* the *stylo-glossus;* and a few fibres of the superior constrictor pharyngis.

620. The *papillæ* upon its mucous membrane are—1st, *papillæ lenticulares, or circumvallatæ,* about fifteen in number; they are situated at the dorsal summit and form an angle, at the apex of which is the foramen cæcum; they resemble inverted cones, and become greatly enlarged in affections of the mucous membranes; 2nd, the *papillæ fungiformes,* more numerous and smaller than the others, are found principally towards the borders and point; 3rd, *papillæ conices,* of a tapering shape, are placed on the dorsum; 4th, *papillæ filiformes* are at the apex.

621. The *nerves* of the tongue are—1st, the *gustatory,* distributed to the papillæ of the sides and tip principally; 2nd, the hypo-glossal to the muscular structure; 3rd, the *glosso-pharyngeal* to the *circumvallatæ* papillæ on the dorsum.

622. The *soft palate* forms a moveable curtain, situated at the posterior aspect of the palatal plate of the palate bone; from its *centre* hangs the uvula, which is muscular; from *this point* extend, on each side, two muscles forming the pillars of the fauces; the two anterior are the *palato-glossi* muscles; the two posterior, *palato-pharyngei;* the *opening* between the arches of either side is

the *isthmus faucium*, and on each side, *between* the palato-glossus and palato-pharyngeus, is placed the *tonsil;* the *soft palate* is stretched by the *tensor*, or *circumflexus palati*, which, arising from the navicular fossa in the pterygoid plate, winds round the hamular process, and is inserted into the lateral surface of the velum, mixing its fibres with those of the *azygos uvula ;* the *levator palati* extends from petrous portion of temporal to same insertion.

623. Stertorous breathing is produced by paralysis of the soft palate; relaxation of the uvula, or overgrowth of it, sometimes requires excision.

624. *Erysipelas* is divided into, 1st, *simple ;* 2nd, *phlegmonous erysipelas.*

1st. *Simple erysipelas*, or inflammation of the skin, is known by its tendency to spread, by the bright-red colour of the rash, by its definite boundary, by the prickling pain, by the disappearance of the redness on pressure, and by the fever and general disturbance of the health.

2nd. *Phlegmonous erysipelas*, or inflammation of the subcutaneous cellular tissue, is known by the *swelling* being greater than in the other, by the *darker* colour of the redness, by the *ill-defined* margin, by the *throbbing* or *aching* pain, by the *greater disturbance* of the constitution, by the *high fever*, and by the great tendency to *suppuration.*

625. *Simple erysipelas* is attended with vesications, and ends in desquamation; unless very severe, it generally yields to calomel and antimony,

with saline purgatives; in more severe cases in plethoric persons, venesection, or the application of leeches may be required; but a species which occurs in elderly persons about the face and head, requires tonic remedies, combined with purgatives.

626. For phlegmonous erysipelas, *the treatment* should be active in the first stage; but as soon as suppuration and sloughing have set in, or even before this, free incisions down to the part are the most effectual means of giving relief.

627. *Senile gangrene* occurs in those parts of the body which are furthest removed from the source of circulation, and in persons whose vitality is weakened by old age, consequent on atheromatous degeneration of and obstruction of the arteries, or emboli. There is livid *discoloration* and *loss of sensibility* in one of the toes; it becomes *colder* than other parts of the body; *vesications* filled with fetid serum form; there is little or *no swelling*, and sometimes even the part is shrunk. When the disease occurs in old persons, generous diet, tonic medicines, and warmth, seem most likely to benefit, but in younger persons *less stimulating treatment* may be required; *opium* is *more beneficial* in this disease than *quinine; amputation* generally inadmissible.

628. *Wounds* are—1st, *incised;* 2nd, *lacerated;* 3rd, *contused;* 4th, *punctured;* 5th, *poisoned;* 6th, *gunshot.*

An *incised wound* is simply a division of some solid structure, and unless of very great extent, or causing division of some cavity or vital organ, is not dangerous. *Treatment.*—To bring the parts into apposition, and keep them so by means of plasters and bandages, that *adhesive union* may take place; if kept quiet, this will occur in twenty-four hours, but if from any cause the parts are displaced, or, from constitutional debility, union does not take place, the wound heals by granulation or the formation of new matter.

629. The *process of granulation* is thus: *coagulable lymph* is thrown out, vessels extend into it, or new ones form; it becomes *organized,* and assumes that peculiar vascular appearance called *granulation.*

2nd and 3rd. *Lacerated* and *contused wounds* do not heal by adhesion, but by granulation, after the removal of effused blood from ecchymosis, or of soft parts from gangrene, has taken place.

630. 4th. *Punctured wounds* are dangerous from the liability of some vital organ or blood-vessels to receive injury; *abscesses* also occur, and the external opening is not sufficient to give passage to the pus.

631. 5th. The most familiar instance of a *poisoned wound* is one received during dissection; persons in whom the circulation is languid are more liable to suffer from these causes, as the absorbents are more active in them.

632. 6th. *Gunshot wounds* bleed less than *incised ones,* but hæmorrhage from the *division of some* internal vessel may cause death; the

wound, where the ball enters, is *small, inverted,* and *marked* by *livid discoloration;* the *exit* of the ball is indicated by a *jagged, everted,* and *larger wound.*

There is great *prostration* in the first instance, succeeded by violent reaction and fever, which may terminate in sloughing, nervous exhaustion, and death.

The *prognosis* must be formed according to the extent, situation, and kind of wound; those *in cavities* being more dangerous than those in limbs, unless the arteries are cut through, the bones much shattered, or the wound extends into a joint.

633. *Treatment*—is to arrest hæmorrhage, to extract bullets, or foreign bodies, to subdue inflammation, and support the patient through the process of exhaustion and suppuration.

634. *Syphilis.*—Two forms of Primary sore—(1) The *simple, soft,* or *phagedænic* sore, *not* infecting, usually affects glans, prepuce or frænum, vulva, fourchette, or nymphæ. It takes the form of irregular, rounded or oval sore. Edges sharply defined, freely moveable on the underlying tissue, *no induration,* round or beneath the sore. If, however, there be any apparent induration from friction or caustics, it is only inflammatory. The matter from this form of chancre reproduces *a similar* sore. Pus from a concurrent abscess *not* innoculable, unless due to absorption of poison from chancre. No constitutional symptoms.

If taken in an early stage the poison may be destroyed by cautery or caustic; later on the sore should be dressed with black wash or some astringent lotion. Saline purgatives, moderate diet, and tonics. In the phagedænic stage, the patient should take iron, quinine, and good diet, and the sloughing surface be destroyed with nitric acid.

(2) *The hard* or *Hunterian Chancre, Infecting Venereal Sore,* usually situated on or behind the glans or prepuce, sometimes in the urethra, or on the labia or vaginal wall. Its period of incubation varies from a week to twenty-eight days; the accruing ulcer is rounded, ill-defined edges, hard and closely adherent to surrounding tissues, with a smooth glazed floor, induration well defined both beneath and at margin. Glands in groin become indurated very soon after induration round primary sore. *Secondary* symptoms usually occur in about six weeks. The after symptoms may be conveniently classified as follows, though of course not necessarily taking precisely this order.

In the first period, *the skin will exhibit :—*

Rose rash, leaving coppery stains.

Papulous and scaly eruption (first appearance).

The mucous membranes and other organs will exhibit :—

Sore throat.

In the second period, *the skin will exhibit :—*

Papular and scaly eruptions (second appearance), mucous tubercle and condylomata, pustular and vesicular eruptions, rupial and ecthymatous forms.

The mucous membrane and other organs will exhibit :—

Ulcerated sores in fauces and mouth, laryngitis, iritis, loss of hair, periostitis.

In the third period, *the skin will exhibit :—*

Serpiginous and lupoid ulcerations, tubercular syphilides.

The mucous membranes and other organs will exhibit :—

Necrosis and caries of bones, destructive ulcerations of larynx, palate, and nose, disease of deep structures of eye, diseases of muscles and viscera, forming tumours.

The disease cannot be attacked from the sore; the fact of incubation shows the disease to be constitutional. Mercury in pill, with henbane, indicated in first period. In early secondary symptoms, mercury in pill, inunction, or bath, with caution, liberal diet. In third period, mercury and tonics, iodide of potass, iron, cod-liver oil, good diet. Local sores to be treated by mercurial ointments.

635. *Hereditary Syphilis.*—Symptoms: small, ill-nourished body, pinched and shrivelled-looking, snuffles, sores about mouth or external genitals, permanent teeth notched and peggy (*Hutchinson's teeth*). Mild mercurial course—by inunction or hydr. cum cretâ, followed by cod-liver oil or iron.

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